Solar and Renewable Resources Technologies

Department of Energy
FY 1998 Budget Request to Congress
(discretionary dollars in thousands)

	FY 1996 Current Appropriation	FY 1996 Comparable Appropriation	FY 1997 Current Appropriation	FY 1997 Comparable Appropriation	FY 1998 Request
Solar and Renewable Resources Technologies					
Solar Energy					
Solar building technology research	1,925	1,925	2,500	2,500	4,000
Photovoltaic energy systems	61,268	61,268	60,000	60,000	77,000
Solar thermal energy systems	24,011	24,011	22,250	22,250	19,800
Biofuels energy systems	53,198	53,198	55,300	55,300	76,540
Wind energy systems	31,420	31,420	29,000	29,000	42,858
Renewable energy production incentive program	——	658	2,000	2,000	4,000
International solar energy program	3,881	3,881	750	750	7,000
Solar technology transfer	10,779	10,779	——	——	1,360
National renewable energy laboratory	2,000	500	3,300	500	2,800
Resource assessment	1,869	1,869	——	——	——
Solar program support	658	——	——	——	——
Total, Solar Energy	191,009	189,509	175,100	172,300	235,358
Geothermal	29,399	29,399	30,000	30,000	30,000
Hydrogen research	14,331	14,331	15,000	15,000	15,000
Hydropower	3,483	3,483	1,000	1,000	1,000
Renewable Indian energy resources	——	——	4,000	4,000	——
Electric energy systems and storage	33,744	33,744	31,750	31,750	45,500
Program direction	12,216	14,391	13,102	13,102	15,642
Subtotal, Solar & Renewable Resources Technologies	284,182	284,857	269,952	267,152	342,500
Use of prior year balances	-15,800	-15,800	-18,932	-18,932	-15,000
Total, Solar and Renewable Resources Technologies	268,382	269,057	251,020	248,220	327,500
Energy Assets Acquisition					
National renewable energy laboratory	——	*1,500*	——	*2,800*	*2,200*

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands, Narrative in whole dollars)

SOLAR AND RENEWABLE ENERGY

EXECUTIVE SUMMARY

Introduction

The mission of the Office of Energy Efficiency and Renewable Energy is to work with our customers to lead the nation to a stronger economy, a cleaner environment, and a more secure future by developing and deploying sustainable energy technologies that meet the needs of the public and the marketplace.

Energy efficiency and renewable energy technologies are among the most cost-effective means available for improving U.S. environmental quality, increasing national energy security and stimulating long term economic growth. Over the last two decades, the Department of Energy's energy efficiency and renewable energy - EERE - programs have produced remarkable successes for America's long-term economic growth, improved environmental quality and continued world leadership in technology. Few Federal programs have produced higher returns on the taxpayer dollar.

In 1995, an independent commission headed by energy expert Daniel Yergin confirmed that two dozen energy efficiency technologies developed with DOE funds are now "generating billions of dollars worth of annual consumer energy savings and new business opportunities, and playing an important role in job creation." Since 1991 we have won 35 R&D 100 awards "...for the most technologically significant new products." This represents 6% of these prestigious international awards during this time. This is more remarkable considering the EERE budget represents less than one-half of one percent of the total U.S. R&D budget.

New energy technologies are instrumental in solving complex interrelated environmental, social, and economic problems. For the government, delivering a new technology to the marketplace is a result of a series of research activities designed to test and develop good ideas that would not otherwise be undertaken by business because of the high individual risk, difficulty in capturing a return on the initial investment, complex cross-cutting nature of the effort, or public nature of the benefits are inappropriate to their necessarily near-term market focus. These research stages involve constant collaboration with customers and partners and include: concept development, market and technical feasibility studies, system and component design, research plans, research, prototype construction and testing at many stages, scale-up demonstrations, and an array of deployment activities. Collectively the stages constitute a research "pipeline" to energy product markets.

In FY 1998 the Office of Energy Efficiency and Renewable Energy plans over 200 R&D projects in various stages of the research pipeline. This year we expect to work with 2000 partners including consortia, laboratories, industry groups, states and retailers that will conduct R&D and

help deploy EE/RE technologies to thousands of sites and users including foreign countries, over 50 clean cities, all 50 states, 800 utilities, 1000 industrial partners and thousands of buildings and demonstration fleet vehicles. Those partner-customers of EERE technologies lead the deployment of energy technologies that will address the needs of the public and the marketplace.

The challenge DOE faces in FY 1998 is to produce beneficial new technologies with fewer resources, maintaining the vital contribution of energy efficiency and renewable energy in the Administration's and Congress' vision. To accomplish this goal, DOE's FY 1998 Budget Request proposes funding for programs that will leverage significant non-Federal investments and will produce high economic, environmental and energy-security benefits, while accelerating the entry of U.S. technologies into the global marketplace.

To meet this challenge we are utilizing existing, effective State deployment networks. Our State grant programs provide cost-effective technical assistance to business and industry. They generate huge non-federal investments in energy projects averaging $19 dollars of public and/or private investments for every federally appropriated dollar.

Situation Report

The following factors were considered in the FY 1998 Congressional Budget Request for energy efficiency and renewable energy:

- National Science Foundation data indicate that the U.S. investment in R&D is in decline. Since 1987, Federal R&D investments have dropped steadily in real terms. Since 1992, private industry R&D has stagnated. And today, less than one-third of private R&D is dedicated to research; the rest is being spent on product and process development.

- At a time of increased public concern about environmental quality and the rising costs of environmental compliance for businesses, energy efficiency and renewable energy technologies offer pollution prevention solutions that often pay for themselves through energy savings and waste reduction.

- As a percent of gross national product, the U.S. national investment in non-defense R&D remains well below that of Japan and Germany. U.S. energy efficiency, measured as energy consumption per dollar of gross domestic product, also remains well below that in Germany and Japan.

- U.S. oil imports are at record levels, are continuing to grow, and are projected by the Energy Information Administration to reach 63 percent by 2005. Oil imports that high would contribute nearly $90 billion to the trade deficit and, according to recent Department of Commerce and GAO analyses, constitute a threat to U.S. economic security. Persian Gulf countries are projected to control 70 percent of the global market for oil by 2010 - making world oil markets increasingly unstable.

- Energy consumption continues to have a real impact on individual Americans. The typical American family of four is spending $2,200 each year on energy -- more than all other expenses except housing.

- Emerging global markets in environmental technologies are potentially worth hundreds of billions of dollars to American industry. Increasingly severe environmental problems plague many of the fastest growing developing nations around the world. Energy efficiency and renewable energy technologies are increasingly seen around the world as a means to reduce the environmental damage caused by energy production and use and industrial production. The demand for these technologies is huge - and growing - and the governments of our economic competitors are, collectively, investing billions of dollars per year to capture these markets.

- Energy efficiency and renewable energy technologies save money, prevent pollution and create jobs today and tomorrow. These technologies range from the advanced wind turbines that provide commercial electricity for more than one million Americans, to more energy efficient appliances in virtually every kitchen, to electronic ballasts saving up to 30 percent on lighting costs - all developed with DOE support. Research on many of tomorrow's best energy technologies is supported by DOE today. Significant Federal disinvestment in this research will lose or substantially delay these technologies and their benefits.

Alignment with Administration Priorities

The energy efficiency and renewable energy programs proposed by DOE for FY 1998 will continue progress toward achieving key goals of the Administration's research and development agenda:

- **Building International Competitiveness with Technology.** Technology development is the key driver of long term economic growth for our nation. Sustained economic growth is dependent upon steady increases in the efficiency of production processes. Technology is the key *enabling input* because it increases the efficiency in which inputs are used, thereby enabling a country to produce more with less. Realizing this fact, governments around the world have historically invested in scientific research and technology development. The federal government has played a pivotal role in developing the world's most successful system of research and development. Maintaining the vigor of research and development is essential to the nation's future and will require the ability to increase funding for new opportunities selectively, even while reducing the overall budget. (*Allocating Funds for Science and Technology*, National Academy of Sciences 1995.)

- **Maintaining world leadership in science, engineering and mathematics.** DOE's National Renewable Energy Laboratory, for example, has won 18 R&D 100 awards since 1982. (The prestigious R&D 100 awards recognize the most important technological advances around the world each year.) Among the widely praised technological breakthroughs among DOE's national laboratories in the last year alone are a low cost aerosol method of sealing heating and cooling ducts in buildings to cut energy losses; a highly efficient

central solar power station; and the grand award winner - a photovoltaic roof shingle that closely resembles conventional shingles yet can produce electricity for homes and businesses directly from the sun.

- **Promoting long-term economic growth that creates jobs.** A growing body of analysis concludes that money invested in energy efficiency produces more jobs than money invested in conventional power production and in a host of other common economic activities. Recently published case studies demonstrate that energy efficiency technologies not only cut costs and save jobs for businesses, but significantly improve their productivity.

- **Improving the nation's environmental quality.** In developing and promoting the efficient use of clean energy resources, DOE's energy efficiency and renewable energy programs result in reduced air, water and ground pollution, often reducing industry environmental compliance costs, concurrent with reduced production costs. In other words, these technologies make environmental progress compatible with economic growth and improved productivity. Estimated reductions in greenhouse gas emissions alone are projected to be 25 million metric tons (MMT) in 2000 and over 100 MMT by 2010. Similar substantial reductions in other air emissions and waste production are projected.

Strategic Priorities

The DOE energy efficiency and renewable energy budget request supports a balanced portfolio of high-priority technology research and development that will achieve the above goals. Key priorities include:

- A Presidential public Partnership for a New Generation of Vehicles, including advanced materials, energy storage, and other new technologies that will triple the efficiency of U.S. passenger vehicles while improving safety and environmental quality;
- Technologies that concurrently meet energy, economic, and environmental objectives, deployed voluntarily through the Climate Change Action Plan;
- Advanced buildings for the 21st century that will use less energy, cost less to build and produce less pollution - yet be more comfortable and productive;
- Advanced biotechnologies for industrial processes and fuel production;
- Advanced power generation technologies using renewable energy resources and building upon recent advances in superconductivity, energy storage and system control technology;
- Technologies leading to improved energy and resource efficiency of energy-intensive industries, which reduce environmental emissions and cut business compliance costs;
- Investments in Federal energy efficiency that cut government operating costs; and
- Investments in State and community energy programs that effectively cut energy costs for small business, industry, and low-income households.

Strategic Principles

To maintain program excellence while minimizing costs, DOE's energy efficiency and renewable energy programs reflect these principles emphasized by the Administration:

Peer Review: In addition to the Yergin Commission review quoted above, DOE's energy efficiency and renewable energy programs for FY 1998 reflect an internal evaluation and prioritization process. Based on the A.D. Little & Co.'s "Third Generation" R&D portfolio analysis, the Office of Energy Efficiency and Renewable Energy has conducted an intensive analysis of all our historic programs resulting in increased focus on our highest priority projects. Completions, efficiencies and strategic review based consolidations, scope and schedule changes, and terminations has allowed us to reduce our spending while maintaining our priorities.

Joint Funding: One method for insuring our technologies are market directed is to collaborate and increasingly cost share our technology development as it moves from basic research to product development. DOE routinely requires cost sharing from industries, states and other program partners ranging from a fractional partners share in risky research to a dominant cost-sharing for scale-up and deployment efforts. The department's goal is to achieve maximum leveraging from Federal funds. In one recent case, for example, $500,000 in Federal funds were used to attract nearly $33 million in state, local and private funds to DOE's Rebuild America program, an initiative that implements energy efficiency technologies in commercial and government buildings at the state and local level.

Multiple Goals: Few Federal programs produce such diverse benefits. Benefits from DOE's energy efficiency and renewable energy activities include: reduced pollution and related health-care costs; reduced oil imports; lower trade deficits; increased local and national economic security; lower consumer energy bills; lower taxpayer costs for energy consumption in public buildings; increased industrial competitiveness; competitive U.S. products for vibrant new export markets; reduced threats of future military actions to assure foreign energy supplies; the creation of new industries and jobs; and hands-on educational opportunities for the next generation of scientists and engineers. DOE energy efficiency and renewable energy programs produce consequential benefits across all these categories this year and will for years into the future.

Performance Measures: The Office of Energy Efficiency and Renewable Energy has developed a peer-reviewed "quality metrics" system that allows DOE to set concrete goals, measure program progress, impacts and success. This evolving strategic management process, while providing valuable input to program planning and improvement, exceeds the requirements of the Government Performance and Results Act of 1994.

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ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands, Narrative in whole dollars)

SOLAR AND RENEWABLE ENERGY

PROGRAM MISSION

Energy is fundamental to the general welfare of a modern nation. This is especially true for the U.S. where the wide availability of affordable and reliable energy drives the engines of our economy and supports our comfortable standard of living. Continued availability of affordable energy is important to all American citizens and is properly a concern for Federal officials. While current energy supplies are generally adequate, growing domestic demand and major increases in worldwide demand lead inexorably toward periodic supply disruptions, scarcity of selected fuels, and price volatility, and perhaps most importantly, environmental damage. With large populations in emerging nations annually creating new appetites for energy driven commodities and services, and with their leaders striving for immediate fulfillment, we are witnessing a concentration of energy resources on raw supply systems, to the detriment of control systems, ultimately leading in turn to undesirable, and potentially unacceptable, environmental consequences. It becomes clear that business-as-usual methods alone will not be adequate for the future. New options will be needed to complement and assist efforts to expand current energy systems. The family of renewable systems proposed in this budget request -- winnowed during the 1980s from examination of over 3 times the technologies presented herein -- offer the most attractive and complete set of energy options to potentially fill this need. The characteristics of environmental friendliness, domestic availability and, once installed, inherent resistance to price escalation that accompany their use constitute an undeniable set of benefits that make adoption of renewable systems a positive step for the U.S. and for other nations as well. Simply stated, the activities and programs described below will establish and ensure clean choices for our energy future. They will also form a cornerstone of the long term international efforts to reduce global emissions of greenhouse gases and transition to a clean energy economy.

The Solar and Renewable Resource Technologies Program funds research and development in two related areas. First, the Program supports R&D of new, efficient, reliable and environmentally sound renewable energy technologies for the utility, transportation, industrial, and buildings sectors. Second, Program funding supports R&D related to advanced utility system technologies necessary for integration of renewable energy systems into the utility grid and that improve the efficiency of the electric sector. In addition, the Program provides support for the initial deployment of solar and renewable energy technologies into domestic and international markets.

Past funding of these R&D activities has yielded remarkable results with respect to renewable energy technology efficiency and economics, bringing the concept of a renewable-based electric power system closer to reality. Royal/Dutch Shell Company's planning group, an internationally recognized leader in energy forecasting and planning, projects significant market share for renewable energy technologies in the first decades of the 21st century, largely based on the technology cost reductions spurred by DOE's R&D investments. The following figures illustrate the dramatic progress made in reducing the costs of these technologies in recent years:

SOLAR AND RENEWABLE ENERGY - PROGRAM MISSION (Cont'd)

The Program's funding request for Fiscal Year 1998 is driven by three objectives central to achieving long-term success:

1. Maintain U.S. technological superiority in renewable energy and advanced utility system technologies by funding a balanced portfolio of R&D in renewable systems and supporting electric technologies.

2. Improve environmental quality through increased use of non-polluting renewable energy technologies, and advanced electric power systems.

3. Expedite the transfer of technology and manufacturing process improvements to the U.S. renewable energy industry which will enable them to increase the deployment of their renewable energy devices systems in the U.S. and to better compete for expanding export markets for renewable energy systems.

Office of Utility Technologies (OUT) Benefits:

Analysis of OUT program benefits indicates that by 2010, 1.2 to 1.7 quads per year of primary energy will be displaced by clean manufactured renewable energy. This is equivalent to not building one hundred coal power plants of 250 MW each. This energy savings will result in multiple benefits for the country. Up to 35 million metric tons of potential carbon equivalent emissions will be reduced, helping the country meet its energy needs without harming the global environment. There are also huge potential economic benefits from the sale of OUT-related technologies in international electricity markets. The International Energy Agency forecasts that by the year 2010, the world will add 1,400,000 MW of electricity capacity, 50% of which will be in developing countries. Over this period, the export market potential for renewable energy technologies will exceed $100 billion.

PERFORMANCE MEASURES:

1. Market penetration and technology substitutions: The ultimate success of an R&D program is in the commercial application of the technology. The commercial applications we see today are the results of R&D conducted several years earlier.

   Thus, while commercialization is the best measure of the success of an R&D program over time, it is not a reliable indicator of the success of any given year's R&D efforts. The performance objectives of the Solar and Renewable Resource Technologies Program for U.S.-produced systems installed domestically and overseas in the year 2000 are:

SOLAR AND RENEWABLE ENERGY - PROGRAM MISSION (Cont'd)

Performance Measures:

Technologies	Installed Electric Capacity by 2000 (megawatts)		Cost of Electric Production (cents per kilowatt-hour)		Other Measures
	Domestic	Overseas	Current	2000	
Photovoltaic	500	200	>20	10 to 15	
Solar Thermal	400	130	17	<8	
Biopower	1,200	8,000			
Wind	2,700	4,000	4 to 5	2.5	
Geothermal	500	2,500	5 to 8	3.5	reduce electric peak loads by 2,000 megawatts from Geothermal Heat Pumps
Hydrogen	N/A	N/A	N/A	N/A	
Solar Domestic Hot Water	Goal: 40-60% increase in market penetration from the current market share.		Goal: 25-40% reduction installation cost from the current cost.		
	Production of Transportation fuels from cellulosic biomass (million of gallons)		Cost of Fuels Production (dollars per gallons)		
	Current	2000	Current	2000	
Biofuels	0	400	1.22	0.90	

2. Improvement of technical indices of system performance: These include photovoltaic conversion efficiency, wind turbine efficiency, geothermal power plant conversion efficiencies, and improving the hot-gas cleanup performance of biomass-powered thermal systems.

3. Initiate and complete proof-of-concept and demonstration projects. All solar and renewable energy technology programs incorporate pilot-scale projects as key elements in the demonstration of the capability and economics of renewable technologies. The ability to successfully complete such projects with industry partners as part of an integrated R&D program is key.

The fiscal year 1998 Solar and Renewable Technology Program is designed to build upon these accomplishments through a focused and intensive R&D effort. This effort will be guided by a strong analytical capability and close consultation and collaboration with the companies and customers that will carry successful technologies into the market.

Key milestones for the renewable energy technology are summarized in the following chart.

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ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Dollars in thousands)

SOLAR AND RENEWABLE ENERGY

PROGRAM FUNDING PROFILE

Sub-Program	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustment	FY 1997 Current Appropriation	FY 1998 Request
Solar Building Technology Research	$ 1,925	$ 2,500	$ 0	$ 2,500	$ 4,000
Photovoltaic Energy Systems	61,268	60,000	0	60,000	77,000
Solar Thermal Energy Systems	24,011	22,250	0	22,250	19,800
Biopower/Biofuels Energy Systems	53,198	55,300	0	55,300	76,540
Wind Energy Systems	31,420	29,000	0	29,000	42,858
Renewable Energy Production Incentive	0	2,000	0	2,000	4,000
Solar Program Support	658	0	0	0	0
International Solar Energy Program	3,881	750	0	750	7,000
Solar Technology Transfer	10,779	0	0	0	1,360
National Renewable Energy Laboratory	500	500	0	500	2,800
Geothermal	29,399	30,000	0	30,000	30,000
Hydrogen Research	14,331	15,000	0	15,000	15,000
Hydropower Development	3,483	1,000	0	1,000	1,000
Renewable Indian Energy Resources	0	4,000	0	4,000	0
Electric Energy Systems and Storage	33,744	31,750	0	31,750	45,500
Program Direction	12,216	13,102	0	13,102	15,642
Resource Assessment	1,869	0	0	0	0
Subtotal	$ 282,682	$ 267,152	$ 0	$ 267,152	$ 342,500
Construction/NREL	1,500	2,800	0	2,800	2,200
Subtotal	284,182	269,952	0	269,952	344,700
Adjustment	0	(18,932)a/	0	(18,932)	(15,000)b/
Total Solar and Renewable Energy	**$ 284,182**	**$ 251,020**	**$ 0**	**$ 251,020**	**$329,700**

a/ Use of prior year balances
b/ Use of prior year uncosted balances

PROGRAM FUNDING PROFILE (Cont'd)

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 94-618, "Energy Tax Act of 1978"
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 95-620, "Powerplant and industrial Fuel Use Act of 1978"
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-12, "National Appliance Energy Conservation Act of 1987"
P.L. 100-615, "Federal Energy Management Improvement Act of 1988"
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989"
P.L. 101-549, "Clean Air Act Amendments of 1990"
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentive Act of 1990"
P.L. 102-486, "Energy Policy Act of 1992"

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Dollars in thousands)

SOLAR AND RENEWABLE ENERGY
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustment	FY 1997 Current Appropriation	FY 1998 Request
I. Solar and Renewable Energy					
A. Solar Building Technology Research	$1,925	$2,500	$0	$2,500	$4,000
1. Space Conditioning and Water Heating	1,925	2,500	0	2,500	4,000
B. Photovoltaic Energy Systems	61,268	60,000	0	60,000	77,000
1. Fundamental Research	9,741	10,000	0	10,000	11,000
2. Advanced Materials and Devices	23,779	24,000	0	24,000	28,000
3. Collector Research and Systems Development	27,748	26,000	0	26,000	38,000
C. Solar Thermal Energy Systems	24,011	22,250	0	22,250	19,800
1. Solar Thermal Electric R&D	18,987	22,250	0	22,250	19,800
a. Thermal Systems Research	6,659	8,450	0	8,450	7,920
b. Power Applications Research	12,328	13,800	0	13,800	11,880
2. Solar Industrial	5,024	0	0	0	0
a. Solar Detoxification	2,777	0	0	0	0
b. Solar Industrial Processes	2,247	0	0	0	0
D. Biopower/Biofuels Energy Systems	53,198	55,300	0	55,300	76,540
1. Biopower Energy Systems	23,218	27,650	0	27,650	36,500
a. Thermochemical Conversion	2,101	1,435	0	1,435	2,815
b. System Development	18,227	18,540	0	18,540	30,685
c. Biomass for Cogeneration	1,130	4,000	0	4,000	3,000
d. Municipal Solid Waste	1,760	0	0	0	0
e. Feedstock Production	0	2,100	0	2,100	0
f. Regional Biomass Energy Program	0	1,575	0	1,575	0
2. Biofuels Energy Systems	$29,980	$27,650	$0	$27,650	$40,040
a. Ethanol Production	$19,094	$22,750	$0	$22,750	$30,040
b. Biodiesel Production	300	750	0	750	1,000
c. Feedstock Development	5,005	2,500	0	2,500	6,000

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Program/Subprogram/Activity	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustment	FY 1997 Current Appropriation	FY 1998 Request
d. Regional Biomass Energy Program	3,806	1,650	0	1,650	3,000
e. Thermochemical Conversion	1,775	0	0	0	0
E. Wind Energy Systems	31,420	29,000	0	29,000	42,858
1. Applied Research	9,900	12,200	0	12,200	14,100
2. Turbine Research	15,320	8,500	0	8,500	19,700
3. Cooperative Research & Testing	6,200	8,300	0	8,300	9,058
4. Technology Development	0	0	0	0	0
F. Renewable Energy Production Incentive Program	0	2,000	0	2,000	4,000
G. Solar Program Support	658	0	0	0	0
H. International Solar Energy Program	3,881	750	0	750	7,000
I. Solar Technology Transfer	10,779	0	0	0	1,360
1. Information & Communications	1,339	0	0	0	1,360
2. Commercialization Ventures	2,840	0	0	0	0
3. Tribal Grants	6,600	0	0	0	0
J. Geothermal	29,399	30,000	0	30,000	30,000
1. Geothermal Electric R&D and Deployment	24,099	23,518	0	23,518	26,518
2. Geothermal Heat Pump Deployment	5,300	6,482	0	6,482	3,482
K. Hydrogen Research	$14,331	$15,000	$0	$15,000	$15,000
L. Hydropower Development	$3,483	$1,000	$0	$1,000	$1,000
M. Renewable Indian Energy Resources	0	4,000	0	4,000	0
N. Electric Energy Systems and Storage	33,744	31,750	0	31,750	45,500

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(Dollars in thousands)

SOLAR AND RENEWABLE ENERGY
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Program/Subprogram/Activity	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustment	FY 1997 Current Appropriation	FY 1998 Request
1. High Temperature Superconductivity R&D	22,280	19,750	0	19,750	32,500
2. Energy Storage R&D	1,977	4,000	0	4,000	4,000
3. Transmission & Distribution R&D	0	0	0	0	0
4. Electric & Magnetic Fields R&D	9,487	8,000	0	8,000	8,000
5. Climate Challenge	0	0	0	0	1,000
O. Program Direction	12,216	13,102	0	13,102	15,642
1. Golden Field Office	2,864	1,570	0	1,570	2,497
a. Salary and Benefits	1,883	1,420	0	1,420	1,465
b. Travel	300	150	0	150	150
c. Support Services	0	0	0	0	0
d. Other Related Expenses	681	0	0	0	882
2. Idaho Operations Office	94	180	0	180	190
a. Salary and Benefits	84	175	0	175	180
b. Travel	10	5	0	5	10
c. Support Services	0	0	0	0	0
d. Other Related Expenses	0	0	0	0	0
3. Headquarters.	11,068	12,732	0	12,732	12,955
a. Salary and Benefits	10,736	10,380	0	10,380	10,560
b. Travel	332	300	0	300	295
c. Support Services	0	0	0	0	0
d. Other Related Expenses	$0	$0	$0	$0	$0
e. Working Capital Fund	$0	$2,052	$0	$2,052	$2,100
4. Adjustment (Actual Unobligated Carryover)	(1,810)	(1,380)	0	(1,380)	0
P. Resource Assessment	1,869	0	0	0	0
Subtotal	282,182	266,652	0	266,652	339,700
Q. National Renewable Energy Laboratory	2,000	3,300	0	3,300	5,000
1. Facility Maintenance	500	500	0	500	2,800

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(Dollars in thousands)

SOLAR AND RENEWABLE ENERGY
PROGRAM FUNDING DETAIL

Program/Subprogram/Activity	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustment	FY 1997 Current Appropriation	FY 1998 Request
2. Construction	1,500	2,800	0	2,800	2,200
Subtotal	284,182	269,952	0	269,952	344,700
Adjustment	0	(18,932) a	0	(18,932)	(15,000) b
Total Solar and Renewable	$284,182	$251,020	$0	$251,020	$329,700
Staffing (FTEs):					
Golden Field Office	26	19	0	19	19
Idaho Operations Office	1	2	0	2	2
Headquarters	114	107	0	107	105
Total FTEs	141	128	0	128	126
a. Use of prior year balances					
b. Use of prior year uncosted balances					

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands, narrative in whole dollars)

PROGRAM FUNDING BY SITE
SOLAR AND RENEWABLE ENERGY

Field Offices/Sites	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustment	FY 1997 Current Appropriation	FY 1998 Budget Request
ALBUQUERQUE OPERATIONS OFFICE					
Albuquerque Operations Office	$2,025	$1,650	$0	$1,650	$0
Atlanta Regional Support Office	50	290	0	290	0
Boston Regional Support Office	1,250	900	0	900	1,140
Chicago Regional Support Office	665	270	0	270	500
Denver Regional Support Office	3,243	490	0	490	875
Seattle Regional Support Office	590	265	0	265	540
Los Alamos National Laboratory	5,959	4,571	0	4,571	5,700
Sandia National Laboratory	31,498	33,912	0	33,912	34,965
National Renewable Energy Laboratory	96,615	75,486	0	75,486	116,302
Golden Field Office	38,750	55,206	0	55,206	78,030
Subtotal, Albuquerque Operations Office	180,645	173,040	0	173,040	238,052
CHICAGO OPERATIONS OFFICE					
Chicago Operations Office	3,020	4,114	0	4,114	3,000
Argonne National Laboratory	3,415	2,911	0	2,911	4,000
Brookhaven National Laboratory	2,030	1,915	0	1,915	1,700
Subtotal, Chicago Operations Office	8,465	8,940	0	8,940	8,700
IDAHO OPERATIONS OFFICE					
Idaho Operations Office	16,927	19,993	0	19,993	15,865
Idaho National Engineering Laboratory	1,275	1,150	0	1,150	1,275
Subtotal, Idaho Operations Office	$18,202	$21,143	$0	$21,143	$17,140

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands, narrative in whole dollars)

PROGRAM FUNDING BY SITE
SOLAR AND RENEWABLE ENERGY

Field Offices/Sites	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustment	FY 1997 Current Appropriation	FY 1998 Budget Request
OAK RIDGE OPERATIONS OFFICE					
Oak Ridge Operations Office	$1,400	$1,200	$0	$1,200	$1,100
Office of Scientific and Technology Information	7	8	0	8	8
Oak Ridge National Laboratory	13,852	13,442	0	13,442	15,919
Subtotal, Oak Ridge Operations Office	15,259	14,650	0	14,650	17,027
RICHLAND OPERATIONS OFFICE					
Pacific Northwest Laboratory	1,100	850	0	850	850
OAKLAND OPERATIONS OFFICE					
Lawrence Berkeley National Laboratory	300	1,150	0	1,150	250
Lawrence Livermore National Laboratory	1,140	2,088	0	2,088	789
Subtotal, Oakland Operations Office	1,440	3,238	0	3,238	1,039
MORGANTOWN ENERGY TECHNOLOGY CENTER	0	114	0	114	
PITTSBURGH ENERGY TECHNOLOGY CENTER	0	290	0	290	0
HEADQUARTERS	59,071	47,687	0	47,687	61,892
SUBTOTAL	284,182	269,952	0	269,952	344,700
Adjustment	0	(18,932) a	0	(18,932)	(15,000) b
TOTAL	$284,182	$251,020	$0	$251,020	$329,700

a. Use of prior year balances
b. Use of prior year uncosted balances

Department of Energy
Climate Change Action Plan Crosscut
(Dollars in thousands)

	FY 1996	FY 1997	FY 1998
Energy & Water Development			
Energy Supply R&D			
Solar and Renewable Energy			
Photovoltaic Energy Systems	$5,000	$3,000	$9,600
Biopower/Biofuels Energy Systems	18,227	18,540	26,685
Geothermal	5,300	6,482	3,482
Electric Energy Systems and Storage	0	0	1,000
International Solar Energy Program	1,900	750	2,500
Total, Solar and Renewable Energy	$30,427	$28,772	$43,267
Total, Energy & Water Development	**$30,427**	**$28,772**	**$43,267**
Interior and Related Agencies			
Energy Conservation			
Buildings Technology, State and Community Sector			
Building Systems Design	$12,048	$12,192	$15,396
Building Equipment and Materials	6,426	7,600	12,072
Codes and Standards	5,800	7,080	11,800
Total, Buildings Technology, State and Community	$24,274	$26,872	$39,268
Federal Energy Management Program	$0	$0	$2,000
Industry Sector - Technology Access	$13,940	$12,950	$24,010
Total, Energy Conservation	$38,214	$39,822	$65,278
Fossil Energy - Coal Mine Methane	$0	$0	$963
Total, Interior and Related Agencies	**$38,214**	**$39,822**	**$66,241**
Total DOE	**$68,641**	**$68,594**	**$109,508**
Total, Energy Efficiency and Renewable Energy (Solar & Renewable Energy and Energy Conservation)	$68,641	$68,594	$108,545

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

SOLAR AND RENEWABLE ENERGY

CAPITAL OPERATING EXPENSES & CONSTRUCTION SUMMARY

Capital Operating Expenses	FY 1996	FY 1997	FY 1998	$ CHG	% CHG
GPP/GPE (total)	$ 500	$ 500	$ 2,800	$ 2,300	460%
Capital Equipment (total)	12,963	5,819	11,250	5,431	93%
Totals	$13,463	$ 6,319	$14,050	$ 7,731	

Construction Project Summary (both Operating and Construction Funded)

Project Number	Project Title	TEC	Previous Approp.	FY 1996 Approp.	FY 1997 Approp.	FY 1998 Request	Unapprop. Balance
96-E-100	FTLB Expansion and Renovation Project, NREL	$6,500	$ 0	$1,500	$2,800	$2,200	$ 0
Total		$6,500	$ 0	$1,500	$2,800	$2,200	$ 0

SOLAR AND RENEWABLE ENERGY

SOLAR BUILDING TECHNOLOGY RESEARCH

I. Mission Supporting Goals and Objectives: The mission of the Solar Building Technology Research Program is to conduct research and development (R&D) on energy producing technologies that will provide economically competitive sources of energy in buildings for our nation. These environmentally clean U.S. based energy technologies will ensure a more secure energy future. This program will work with partners and customers to ensure that technologies are developed that will meet the needs of the public and the marketplace, improve the environment and guarantee continued global competitiveness. R&D goals are to develop solar building technologies which are competitive with electricity in the near term and gas/oil in the long term. The objective is to overcome the remaining barriers of reliability, consumer awareness/confidence, and high first cost. Achieving this objective will accelerate technology deployment in the building sector.

Since the mid-1970's an estimated 1.2 million solar water heating systems have been installed nationwide, generating an estimated 25,000 job-years of employment. Based on Energy Information Agency surveys over the past ten years, the domestic and international market for U.S. manufacturers is approximately 15,000 solar domestic hot water systems annually. While this is great progress, it represents only 1% of the domestic and a minor fraction of the international water heating market potential. The solar water heating industry consists of fragmented and small entrepreneurial businesses in a labor intensive business which provides almost exclusively low to moderate income blue collar jobs. This fledgling industry does not have, nor can it afford, the kind of technical expertise provided by the solar program in addressing significant technical barriers to the widespread utilization of this promising technology. Technical feasibility and market viability has been established, but widespread utilization of this technology requires a sustained solar buildings program effort in partnership with the industry.

Today the solar water heating industry is experiencing a tremendous rebirth of interest and slow, but steady growth within the public and private sectors. This includes a collaborative involving almost 100 utilities with the potential for providing additional market penetration growth of 100-300% in the next 3-5 years. This growth requires the technical reassurances provided by the specific activities of the Solar Buildings Appliances R&D Program. These activities will be instrumental in developing a technology base which will reduce the cost of solar water heating to 4 cents per kWh and the cost of solar air heating to 1 cent per kWh. Achieving these goals will make these technologies very cost-competitive with electricity (for water heating) and natural gas (for air heating), enabling significant market penetration.

The Solar Buildings Technology Research program has invested in solar technologies for building applications since 1974. After federal tax credits expired in 1985, efforts focused on the most cost-effective applications such as solar domestic hot water. As a result, the cost of solar energy has dropped from about 20 cents per kWh in 1980 to about 8 cents per kWh today. Research supported by DOE also led to a technical breakthrough (the transpired solar collector) which reduced the cost of solar air heating from about 20 cents per kWh in 1980 to about 2 cents per kWh today by increasing system efficiency from 30% to 70% and reducing system costs by a factor of 5.

More than one million solar systems have been installed in residential and commercial buildings in the U.S. These systems currently displace more than 2600 megawatts (thermal energy equivalent) and 840 megawatts of utility peak demand. However, this is less than 1% of the

I. Mission Supporting Goals and Objectives (Cont'd):

potential buildings market. To increase market penetration, the program has parallel efforts in: 1) **quality assurance** activities to ensure deployment of certified and tested systems, 2) **technology deployment** activities collaborating with the solar industry, builders, utilities, and energy service companies to develop effective means to deliver the technology to end-users, and 3) **technology development** activities to develop advanced designs to reduce the costs of delivered energy so that it meets customer requirements.

Quality Assurance. The program, working in collaboration with the industry, is finalizing a major effort in development of a national rating and certification program to address quality assurance issues.

Technology Deployment. The program is working with interested utilities in the USH2O (utility solar hot water) initiative to develop the energy service company approach for delivering solar water heating to end-use customers in new utility programs across the country. The program is also working with the Building Industry to identify the improvements necessary to make solar technology fully acceptable for the new construction market. The program will coordinate with utilities, builders, land developers and other potential end-users to keep them abreast of the changes in the technology. It will do this through cost-shared demonstrations, providing system performance and reliability data, and developing educational literature.

Technology Development. A major thrust for the program will be focused on technology R&D that reduces the cost and increases the service life of the technology. Today's solar building technologies have the advantage of competing with retail utility rates rather than utility generation costs and are in theory cost-effective on a life-cycle cost basis. However, to actually achieve significant market penetration, these technologies must provide the very short paybacks (or high rates of return) required by end-users. By bringing costs down to 4 cents per kWh for solar water heating and 1 cent per kWh for solar air heating by 2000, the Solar Buildings Appliances R&D program will help make solar heating a cost-effective option for residential, commercial, and industrial customers across the country. The program will also conduct R&D to develop new cost-effective applications for low-temperature solar technologies.

This three-pronged strategy will result in reliable, low-cost solar systems and informed customers. By the year 2000, solar building technologies will produce $90 million in annual energy savings and an annual reduction of 0.24 million metric tons of carbon equivalent.

SOLAR AND RENEWABLE ENERGY

SOLAR BUILDING TECHNOLOGY RESEARCH (Cont'd)

I. Mission Supporting Goals and Objectives (Cont'd):

A. Estimates of Benefits:

At the proposed funding levels, the Solar Building Technology Program is expected to yield the following quantifiable benefits:

	1996	1997	1998	2000	2010	2020
Total Primary Energy Displaced (Quads)	.030	.030	.031	.033	.073	.248
Total Cost Savings (Millions $ 1995)	230	235	243	$259	$564	$1,909
Carbon Equivalent Emissions (MM Tons)	0.57	0.58	0.60	0.64	1.43	4.87

B. Performance Measures (highlights):

Goals for 2000

The following performance measures will allow the Solar Buildings Appliances R&D Program to determine progress toward the program goals for 2000 of reducing the cost of solar water heating from 8 cents per kWh today to 4 cents per kWh and the cost of solar air heating from 2 cents per kWh today to 1 cent per kWh. Additionally these measures will assure progress towards increasing system life expectancies from a range of 10-15 years to 15-20 years for both hot water and air heating systems.

FY 1996 Performance Measures

- 2 additional utility cost-shared solar building initiatives were put in place for developing markets that are expected to lead to a 10-20% reduction in installed system cost.

- Identified key component development needs for low-cost solar domestic hot water systems with potential for 20-30% reduction in installed system cost.

I. Mission Supporting Goals and Objectives (Cont'd):

- 3 states/utilities began using industry voluntary rating and certification procedures.
- National sales of 4,000 solar domestic hot water systems (0.12% of 1993 total annual DHW market).

FY 1997 Performance Measures

- Work with builders, utilities, the solar industry, and other potential customers to develop a new strategic plan for the program and identify technology improvements required for solar hot water to become an integral part of the *new construction* market.
- 2-4 additional utility cost-shared solar building initiatives in place for developing markets leading to a 10-20% reduction in installed system cost.
- Initiate prototype development of industry cost-shared initiatives for next generation of solar domestic hot water equipment with 25-40% increased cost effectiveness.
- Completed the conceptual design of an optimum balance of plant.
- Initiate industry cost-shared development of fully-certified integrated balance of system/tank module to meet national building codes leading to a 15-25% reduction in installed cost with increased service reliability/durability.
- National sales of 6,500 solar domestic hot water systems (0.19% of 1993 total market).

FY 1998 Performance Measures

- Implement the new strategic plan; which is expected to include addressing the *new construction* market and providing technical and educational support to the building industry.
- Total of 6-10 utility solar building initiatives in place for developing markets leading to a 20-30% reduction in installed system cost.
- Total of 14-18 states using industry voluntary rating and certification procedures.

SOLAR BUILDING TECHNOLOGY RESEARCH (Cont'd)

I. Mission Supporting Goals and Objectives (Cont'd):

- National sales of 10,000 solar domestic hot water systems (up to 0.29% of 1993 total market).
- First system manufactured using the integrated balance of systems concept reaches market.
- First prototype installation of unglazed transpired collector system specifically designed for highly replicable pre-fabricated and pre-engineered buildings sector.

FY 1999-2002 Performance Measures

- Deploy solar heating technologies capable of producing solar water heating and solar air heating energy savings at costs of 4 cents per kWh and 1 cents per kWh, respectively.
- National sales of 40,000 solar domestic hot water systems (1% of 1993 total market).
- Deploy combined solar photovoltaic/thermal (PV/T) collectors capable of 100% increase in energy performance with an effective 50-60% reduction in energy cost over PV alone systems for buildings.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
Space Conditioning and Water Heating	$ 1,925	$ 2,500	$ 4,000	$ 1,500	+60%
Total, Solar Building Technology Research	**$ 1,925**	**$ 2,500**	**$ 4,000**	**$ 1,500**	**+60%**

III. Performance Summary - Accomplishments:

Space Conditioning and Water Heating	FY 1996	FY 1997	FY 1998
Quality Assurance: 1996 - Completed transition of national certification program from development to application for 80% of the solar domestic hot water system types. 1997 - Completed technical support on remaining solar system reliability issues for a voluntary, industry driven National Rating and Certification Procedure for all solar domestic hot water system types; completed transfer of implementation process for certifying solar systems to industry. 1998 - Provide technical support to expand rating and certification procedures for new system designs being developed by industry.	$475	$350	$325
Technology Deployment: 1996 - Validated economic viability of utility-energy service company (ESCO) model program structure for solar domestic hot water systems; evaluated persistence of savings impact assessment under local/regional conditions for utility/ESCO consortia developing solar initiatives. 1997 - Provided technical support to utility/ESCO consortia to establish 2-4 utility-energy service company initiatives resulting in 40-60% increased market penetration rate and 25-40% reduction in installed system cost; established industry/builder consortia for developing solar initiatives in new construction market. 1998 - Establish an additional 2-4 utility-energy service company solar initiatives resulting in an additional 20-30% increased market penetration rate; provide technical support to industry/builder consortia resulting in 1-2 community scale solar initiatives in the *new construction* market. Provide educational material and technical data from those community scale systems to the consortia and others in the Building Sector.	$425	$1,050	$1,525

SOLAR BUILDING TECHNOLOGY RESEARCH (Cont'd)

Space Conditioning and Water Heating (Cont'd)	FY 1996	FY 1997	FY 1998
Technology Development: 1996 - Completed conceptual designs for two advanced solar systems with 15-20 year service lives at sustained levels of performance with 15-30% reduction in life-cycle cost. 1997 - Released 2 RFPs for industry cost-shared development of advanced prototype designs and advanced manufacturing processes for solar building equipment offering 30-50% increased cost effectiveness and 20 year service lives. 1998 - Complete initial prototype testing of integrated balance of systems and low-cost solar domestic hot water systems concepts; complete installation of unglazed transpired collector system specifically designed for highly replicable pre-fabricated and pre-engineered buildings; develop prototypes of new R&D advanced system concepts identified in FY 1997.	$1,025	$1,100	$2,150
TOTAL Solar Buildings Technology Research	**$1,925**	**$2,500**	**$4,000**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Space Conditioning and Water Heating: The 60% increase in the FY 1998 request will enable an increased coordination between the program and builders, developers, utilities, energy service companies, and other potential customers of the solar technology. This will lead to a new "customer focused" strategic plan for the program. An expanded technology development effort will identify and develop advanced components that result in decreased system costs of 50%. The increase in funding will also allow deployment of these lower cost systems in several communities. Analysis and evaluation of these systems will form the basis of an ongoing educational relationship with the customers.

This increase in funding will thus provide necessary resources to help make the technology cost competitive with electric systems in the near term (year 2000) and gas systems in the long term (year 2005). ($+1,500,000)

SOLAR AND RENEWABLE ENERGY

PHOTOVOLTAIC ENERGY SYSTEMS

I. Mission Supporting Goals and Objectives: The mission of the Photovoltaic Technology Program is to conduct the research and development (R&D) necessary to develop an economically competitive source of electricity for our nation, thereby ensuring a more secure energy future. R&D goals are to increase the conversion efficiency and performance of photovoltaic devices, reduce manufacturing costs of components and systems, and increase the reliability and lifetime expectancy of modules and installed systems.

Photovoltaic R&D activities are integral to advancing the science and technology base that will maintain steady progress toward long-term goals of improved performance and lower costs. The U.S. photovoltaic industry is currently experiencing annual growth rates exceeding 25% in international and domestic sales. This is the direct result of U.S. science and engineering leadership over the past 20 years. A strong R&D program is essential to maintain our nation's world leadership in this strategic energy industry, which produces high-technology jobs and product exports. Advanced photovoltaic R&D is still considered by industry to be too high-risk and long-term to support on its own. Therefore, a key element of the PV program is to cost-share advanced R&D and technology improvement in cooperation with industry for its development of globally-competitive products.

The FY 1998 budget presents a balanced effort in fundamental and applied research, materials and device development, manufacturing process R&D, module reliability, and system testing and evaluation. A major portion of the budget will be used in competitive procurements to fund highly leveraged cost-shared projects with U.S. utilities and the emergent PV industry.

Fundamental research activities will continue on several photovoltaic semiconductor materials to resolve issues that limit current technology, and to develop new ideas for next generation (post-2000) technologies. Advanced materials and devices work will continue cost-shared research with industry to improve device efficiency and stability, particularly for large-area thin-film deposition systems. Manufacturing process R&D will continue cost-shared industry research to reduce module manufacturing costs, improve module performance, and stimulate investment in new manufacturing production lines. These research activities are core program efforts to develop the advanced technologies that are essential to maintaining U.S. competitiveness in the next 5 to 10 years. Module reliability research will continue to support reliability testing of modules to improve operational lifetime in the field. System component reliability efforts will be increased to help increase the lifetime of fielded systems. In cooperation with the Utility Photovoltaic Group (UPVG), efforts will be continued to complete cost-shared utility projects designed to establish technical and economic validation in specific high-value applications. In addition, research and analysis relating to restructuring in the electric utility industry will be conducted on issues associated with integration of photovoltaic systems into an increasingly competitive industry framework. Additional fundamental research on solar resource characteristics will identify cost-competitive options for systems integration.

I. Mission Supporting Goals and Objectives (Cont'd):

A. Estimates of Benefits

At the proposed funding levels, the Photovoltaic Technology R&D Program is expected to yield the following quantifiable benefits in the U.S. only; these are cumulative benefits assuming a baseline of zero in 1996 for grid connected power modules:

	2000	2010	2020
Annual Primary Energy Displaced (Quads)	0	0.03	0.27
Annual Displaced Electricity Value ($0.07/kWh)	0	$79 M	$916 M
Carbon Equivalent Emissions Reductions (MMT)	0	0.61	5.31

The U.S. photovoltaic industry has been growing at an annual rate of 20-25% over the past five years and is now the leader in sales throughout the world. In 1995, 70% of sales were exported to foreign markets. The strong and aggressive DOE R&D program has been the key to enabling the U.S. PV industry to be the technology and product leader in a very competitive and rapidly growing global marketplace.

B. Performance Measures

Goals for 2000

- Increase the conversion efficiency of commercial thin film modules from the current 7% to 10% and from the current 13% to 15% for crystalline silicon.
- Reduce the retail sales price of commercial modules by 30% from current average costs of about $4.25/watt.
- Increase U.S. PV industry cumulative sales of power modules by 185% from 175 megawatts in 1995 to 500 megawatts (U.S. and export sales).

I. Mission Supporting Goals and Objectives (Cont'd):

FY 1996 Performance Measures

- Develop a 17% efficient prototype thin-film solar cell.
- Develop a 19% efficient crystalline silicon large-area cell on a low-cost material.
- U. S. PV module shipments increase to over 40 megawatts.

FY 1997 Performance Measures

- Complete construction and begin testing and evaluating the 11 UPVG Round 1 utility PV systems totaling 5.6 megawatts of installed capacity.
- Test a low-cost, improved module encapsulant with 25 or more-year lifetime.
- Achieve greater than 9% efficient thin-film large-area commercial modules.
- Evaluate performance of a thin-film PV roofing shingle on several buildings.

FY 1998 Performance Measures

- Develop an 18% efficient prototype thin-film solar cell.
- Reduce retail sales price by 50% from present baseline of about $4.25 per peak watt.

FY 1999-2002 Performance Measures

- Develop 13% efficient stable prototype amorphous silicon solar cells. (1999)

I. Mission Supporting Goals and Objectives (Cont'd):

- Develop 13% efficient stable prototype thin-film module. (2000)
- Test a low-cost, stable module encapsulant compatible with 30-year module life. (2001)
- Increase the number of systems by 100% to achieve greater than 300 megawatts of cumulative installed PV systems in the U.S. (2002)

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
Fundamental Research	$ 9,741	$ 10,000	$ 11,000	$ 1,000	10%
Advanced Materials and Devices	23,779	24,000	28,000	4,000	17%
Collector Research and Systems Development	27,748	26,000	38,000	12,000	46%
Total, Photovoltaic Energy Systems	**$ 61,268**	**$ 60,000**	**$ 77,000**	**$ 17,000**	**28%**

III. Performance Summary - Accomplishments:

Fundamental Research	**FY 1996**	**FY 1997**	**FY 1998**
Measurement & Characterization: 1996 - Established several new efficiency records for polycrystalline thin film modules, including a 12.4% copper indium diselenide (CIS) submodule. 1997 - Supported industry and university research groups in advancing material and cell technologies by characterizing cell materials and devices; and reducing defects in cell materials. 1998 - Increase efforts to assist university and industry researchers characterize cell materials and devices, reduce defects and develop improved cell structures and materials processing; measure and characterize over 15,000 cell samples for industry, university, and national laboratory research groups during the coming year.	$5,000	$5,000	$5,500
Basic Research/University Programs: 1996 - Improved the efficiencies for thin-film technologies based upon polycrystalline cadmium telluride, copper indium diselenide, and silicon materials (e.g., polycrystalline copper indium gallium diselenide (CIGS) photovoltaic cell technology from an efficiency of 17.1% to 17.7%). 1997 - Developing solutions for improved cell structures and materials processing; and developing several new materials and cell structures, including a new transparent conducing oxide (TCO) film for thin-film modules. 1998 - Develop and characterize new prototype module and cell materials and devices based upon thin-film and crystalline materials; and, advance the understanding of new and novel materials, cell structures, deposition methodologies, semiconductor theory, and measurement and characterization methods and standards.	**$4,741**	**$5,000**	**$5,500**
TOTAL Fundamental Research	**$9,741**	**$10,000**	**$11,000**

Advanced Materials and Devices	**FY 1996**	**FY 1997**	**FY 1998**
Thin-Film Partnerships: 1996 - Demonstrated and improved a number of material deposition technologies for photovoltaic cells and modules (e.g., the new patented hot-wire deposition methodology being developed for the manufacture of amorphous silicon cells and modules to produce device quality amorphous silicon films with greater stability and higher stable efficiencies than the current glow-discharge deposition methodology); and transferred laboratory cell technology for thin-film and concentrator cell materials to more than 10 U.S. photovoltaic cell manufacturers who are selling commercial cells and modules as a result of these technology advancements. 1997 - Achieve new state-of-the-art advances in the scale-up and commercialization of thin-film and crystalline silicon technology for thin-film partnership contracts resulting in 11.5% efficient stabilized amorphous silicon cell (1 cm^2) and a 9% stable module (900 cm^2); a 9.5% efficient CdTe module; and a 13.5% efficient CIS submodule. 1998 - Will increase efforts within the thin-film partnership program to accelerate achievement of cost-effective thin-film technologies.	$16,000	$16,000	$20,000
Crystalline Silicon/High Efficiency Devices: 1996- Achieved a number of world record efficiencies in the crystalline silicon and thin-film technologies (e.g., 18.6% efficient polycrystalline silicon cell at the Georgia Institute of Technology, one of two DOE PV program Centers of Excellence); 1997 - Conduct advanced reliability testing of more than 50 laboratory and commercial cells, modules and balance of system components in support of industry's efforts to extent lifetime warranties on PV modules from the current 10-20 years for commercial products to 20-25 years.			

SOLAR AND RENEWABLE ENERGY

PHOTOVOLTAIC ENERGY SYSTEMS (Cont'd)

Advanced Materials and Devices (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
Crystalline Silicon/High Efficiency Devices (Cont'd): 1998 - Will develop new and improved materials and balance-of-systems components (e.g., an improved, low-cost, highly-stable module encapsulant with potential for greater than 25-year life compared to today's 20-year life); and increase R&D activities to extend the lifetime and reliability of balance-of-systems components toward 25-year lifetimes and to reduce total installed costs by up to 50%.	**$7,779**	**$8,000**	**$8,000**
TOTAL Advanced Materials and Devices	**$23,779**	**$24,000**	**$28,000**
Collector Research and Systems Development			
Photovoltaic Manufacturing Technology Project: 1996 - Improved manufacturing processes and reduced manufacturing costs at more than ten photovoltaic manufacturing companies involved in the Photovoltaic Manufacturing Technology Project (PVMaT) (e.g., cooperated with U.S. industry to reduce overall module production costs by greater than 50%). 1997 - Near completion of the highly-successful PVMaT R&D Project initiated in 1990 to improve the manufacturing processes and cost reduction for current commercial photovoltaic modules technologies; and continue manufacturing R&D process improvements and cost reductions for the new thin-film technologies emerging from the successful laboratory R&D thin-film initiative activities. 1998 - Increase efforts to improve manufacturing processes for thin-film technologies emerging from successful laboratory R&D activities and assist U.S. industry in the development the advanced manufacturing technology for producing higher performance and lower-cost commercial thin-film modules.	$8,200	$9,600	$10,000

Collector Research and Systems Development (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
Systems Engineering & Reliability: 1996 - Increased U.S. photovoltaic power module sales by 35% from 1994 to 1995 through cooperation with industry and utility companies in the improvement and demonstration of installed systems. Assisted in transfer of world-record efficiency monolithic tandem-junction cell to the space industry. 1997 - Continue improving the performance and reliability of balance of system components, with particular attention to new commercial equipment. 1998 - Collaborate with U.S. industry to increase module and balance-of-systems manufacturing efficiency and throughput to achieve additional cost-reduction of about 35% for installed systems in the year 2000 (a savings of about $2.50 per watt) and higher system performance and reliability resulting from improved manufacturing process technology, efficiency and quality control.	$12,548	$12,400	$14,400
PV Building Opportunities: 1996 - Install several prototype products integrated into residential and commercial buildings. 1997 - Complete Building Opportunities in the U.S. for Photovoltaics (PV:BONUS) contracts resulting in five new PV products that can be integrated into commercial and residential buildings, and assess the projects' results. 1998 - Assess the performance of installed systems and issue an new solicitation for development of building-integrated photovoltaic product development.	$2,000	$1,000	$4,000
Climate Change Action Plan: Partnerships for Technology Introduction: 1996 - Complete the construction and continue the monitoring and evaluation of the eleven Utility Photovoltaic Group (UPVG) projects initiated in FY 1995.			

Collector Research and Systems Development (Cont'd)	FY 1996	FY 1997	FY 1998
Climate Change Action Plan: Partnerships for Technology Introduction (Cont'd): 1997 - Continue the construction of eight more projects initiated in FY 1996. 1998 - Issue UPVG request for proposals for an additional 6 megawatts of installed capacity under the Climate Change Action Plan.	$5,000	$3,000	$9,600
TOTAL Collector Research and Systems Development	**$27,748**	**$26,000**	**$38,000**
TOTAL Photovoltaic Systems R&D	**$61,268**	**$60,000**	**$77,000**

***FUNDING CHANGES FROM FY 1997 TO FY 1998*:**

Fundamental Research: This funding increase will maintain the world-class research capabilities at our nation's laboratories and provide for the exploration of advanced concepts that provide improved technology into the post-2000 time frame. (+$1,000,000)

Advanced Materials and Devices: The increase of $4,000,000 will provide six additional industry/university R&D partnerships in support of thin-film research and engineering. Thin-film technology shows great promise for reducing costs of electric power delivered by PV systems. The focus is on forming partnerships with industry and on utilizing the extensive expertise available in university science and engineering departments. (+$4,000,000)

Collector Research and Systems Development: The increase of $12,000,000 will provide $6.6 million for the Utility Photovoltaics Group (UPVG) to issue a new request for proposals for an additional 5.7 megawatts of installed capacity under the Climate Change Action Plan, $2.4 million to increase efforts in thin-film manufacturing and balance of systems (BOS) reliability research, and $3 million to increase product development efforts for building integrated photovoltaics. (+$12,000,000)

(+$17,000,000)

SOLAR AND RENEWABLE ENERGY

SOLAR THERMAL ENERGY SYSTEMS

I. Mission Supporting Goals and Objectives: The mission of DOE's Solar Thermal Electric (STE) Program is to work with developers, manufacturers, and users of solar thermal electric technology to: (a) develop reliable and efficient solar thermal electric systems that will generate economically competitive power to improve our nation's energy security through greater diversity of supply; (b) reduce the environmental impacts of energy production; and (c) proactively support the development of these technologies to penetrate peaking and intermediate power generation markets with new energy applications, thus creating business opportunities in the U.S. and abroad and jobs for U.S. workers.

Solar thermal electric power is an attractive renewable energy option for the U.S. market due to its load-following capability during peak demand, and utilization of thermal storage to meet high-value peaking and intermediate power needs. In addition, a World Bank study has shown that the small land-use requirements and high efficiency of solar thermal systems make it a leading candidate to provide a significant portion of the world-wide electric generation capacity. In that regard, Rajasthan, India, has developed a "Solar Energy Enterprise Zone " in which they will pay 9¢/kWh for solar energy because they believe, for their country, solar energy will be more cost-effective than fossil fuel. The ability to export high-tech solar components can serve as an economic stimulus creating jobs in America, providing significant environmental and ecological benefits. In order to capture these opportunities, the STE Program, in conjunction with the industry and user communities, has developed a leveraged cost-shared program to support the technology research and development necessary to achieve electric generation cost in a competitive range (less than 8¢/kWh).

The goal of the Solar Industrial Program was to facilitate the increased use of solar energy within the industrial sector. Due to the need to reduce Federal spending and to higher priorities in other areas, funding for solar thermal processing has not been requested for FY 1997 or FY 1998 and orderly closeout of program activities will take place.

A. Estimates of Benefits At the proposed funding levels, the STE Program is expected to yield the following quantifiable benefits; these are cumulative benefits assuming a zero baseline in 1996:

	2000	2010	2020
Annual Primary Energy Displaced (Quads)	0.00	0.07	0.34
Annual Displaced Electricity Value ($M @ 0.07/kWh)	$9	$472	$2,360
Carbon Equivalent Emission Reduction (MMT)	0.02	1.00	2.00

I. Mission Supporting Goals and Objectives (Cont'd):

Solar thermal technologies currently account for 354 MW of installed capacity in the U.S. With the availability of World Bank funding through its Solar Initiative, industry is projecting to add an additional 500 MW (120 MW trough, 250 MW power tower, and 130 MW dish/Stirling systems) in the U.S. and abroad by the year 2002.

B. Performance Measures (highlights) The following performance measures will be used by the Solar Thermal Program to track its commitment to help bring these technologies into the marketplace:

FY 1996 Performance Measures

- Dedicated the 10MW Solar Two Power in Southern California and initiated operation.
- Logged over 300 hours on SAIC's 25kW Phase I (deisgn validation system).
- Deployed six 7kW dish/engine systems at user sites across the U. S.

FY 1997 Performance Measures

- Deploy two 25-kW dish/engine systems at utility and user sites in the U.S. Southwest in order to validate design and performance.
- Achieve full-rated 10 MW power output at Solar Two power tower in California and demonstrate 3 hour operation after sunset.
- Construct and deploy two Phase II (manufacturing evaluation) heliostats for on-sun testing.

FY 1998 Performance Measures

- Deploy a minimum of two additional 25-kW dish/engine systems at utility and user sites in the U.S. Southwest. Log 750 hours of automated operation on a single dish/engine unit in the field.
- Achieve 90% system availability at Solar Two and produce 1,500 MW-Hrs over any given one month period.

SOLAR THERMAL ENERGY SYSTEMS (Cont'd)

I. Mission Supporting Goals and Objectives (Cont'd):

- Construct and deploy two additional Phase II (manufacturing evaluation) heliostats at a utility site in Southern California for on-sun testing.

FY 1999 - 2002 Performance Measures

- Commercial sales of 130 MW of the utility-scale (25-kW) dish/engine systems, leading to the creation of 1000 new jobs.
- Installation and operation of an additional 370 MW of commercial solar thermal electric systems (120 MW trough, 250 MW power tower) in the U.S. and abroad.
- Reductions in the cost of solar thermal electric power from the current 17¢/kWh to under 8¢/kWh

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
Solar Thermal Electric R&D					
Thermal Systems Research	$ 6,659	$ 8,450	$ 7,920	$ -530	-6%
Power Applications Research	12,328	13,800	11,880	-1,920	-14%
Total Solar Thermal Electric R&D	$ 18,987	$ 22,250	$ 19,800	$ -2,450	-11%
Solar Industrial					
Solar Detoxification	$ 2,777	$ 0	$ 0	$ 0	0%
Solar Industrial Processes	2,247	0	0	0	0%
Total Solar Industrial	$ 5,024	$ 0	$ 0	$ 0	0%
Total, Solar Thermal Energy Systems	**$ 24,011**	**$ 22,250**	**$ 19,800**	**$ -2,450**	**-11%**

III. Performance Summary - Accomplishments:

Solar Thermal Electric R&D - Thermal Systems Research	**FY 1996**	**FY 1997**	**FY 1998**
1996 - Entered 2nd year of 5-year acceptance test program for polymer and thin-glass films. Continued on-sun testing of second-generation hybrid (solar/natural gas) reflux receivers for 25-kW dish/engine systems. Incorporated new high-temperature gas receiver on dish/Brayton system. Validated new power tower receiver materials under Rockwell CRADA. Provided Solar Two technical support. 1997 - Enter 3rd year of optical materials outdoor acceptance test program. Initiate testing of stretched-membrane heliostats at Solar Two. Install first-generation hybrid (solar/natural gas) reflux receivers on 25-kW dish/Stirling systems for field testing. Continue Solar Two technical support and research related to molten-salt receiver. Continue life-cycle testing of Stirling and Brayton dish/engine systems on-sun. Initiate long-term R&D projects. 1998 - Enter 4th year of optical materials outdoor acceptance test program. Complete validation of hybrid reflux receivers for commercial applications. Continue Solar Two technical support and research related to molten-salt receivers. Complete life-cycle testing of Stirling and Brayton dish/engine systems on-sun. Complete validation test of advanced dish/engine system for commercial applications. Continue systems research and long-term R&D efforts.	$6,659	$8,450	$7,920
TOTAL Solar Thermal Electric R&D - Thermal Systems Research	**$6,659**	**$8,450**	**$7,920**
Solar Thermal Electric R&D - Power Applications Research			
Dish/Engine Development: 1996 - Built a proof-of-concept 25-kW dish/engine system as part of Phase I of the USJVP. The unit has logged over 300 hours on-sun at SAIC's test facility in Golden, Colorado. Phase II Commenced.			

Solar Thermal Electric R&D - Power Applications Research (Cont'd)	FY 1996	FY 1997	FY 1998
Dish/Engine Development (Cont'd): 1997 - Dish/engine manufacturer contracted with utility partners to purchase and install two 25-kW units. These second generation systems will incorporate design changes to improve performance and reliability. 1998 - Build and install a minimum of two additional 25-kW dish/engine systems. Log 750 hours of "continuous" automated operation on a single dish/engine unit in the field. Phase III plans call for a deployment of up to 3MW of dish/engine systems for evaluation under commercial conditions.	$5,268	$4,300	$3,820
Power Tower Development: 1996 - Completed the construction and startup of the 10 MW Solar Two power tower pilot plant. Initiated formal testing and operation of Solar Two. 1997 - Complete acceptance test and evaluation phase and initiate the power production phase of Solar Two. 1998 - Establish routine operations at Solar Two. Optimize plant performance, and establish the technical and operational feasibility of future commercial power tower plants. Additional funding needed to match non-DOE contributions to fix problems experienced at plant startup.	$4,640	$4,520	$4,550
SolMaT Initiative: 1996 - Completed technology evaluation and begin manufacturing evaluation phase for two heliostat designs. Placed two additional contracts, one for an advanced state-of-the-art molten salt power tower receiver, and the other for a composite dish/engine concentrator. 1997 - Fabricate and deploy heliostats and advanced state-of-the-art power tower receiver panels for manufacturing validation. Complete the manufacturing evaluation of a composite dish/engine concentrator.			

SOLAR AND RENEWABLE ENERGY

SOLAR THERMAL ENERGY SYSTEMS (Cont'd)

Solar Thermal Electric R&D - Power Applications Research (Cont'd)	FY 1996	FY 1997	FY 1998
SolMaT Initiative (Cont'd): 1998 - Install advanced heliostats and state-of-the-art power tower receiver panels at Solar Two for evaluation in a utility environment. Build composite dish/engine concentrator for manufacturing validation.	$1,520	$1,930	$1,880
Systems and Markets/Industrial Assistance: 1996 - Assisted US industry by validating tax equity studies related to solar thermal technologies. Worked with potential U.S. trough developers in receiving World Bank support for projects in Mexico, India, and Egypt. Evaluated the feasibility of hybrid (solar/fossil) power tower plants for deployment within many developing nations around the world. Assisted domestic trough manufacturers in reducing O&M costs. 1997 - Broaden tax equity studies to incorporate other renewables. Support U.S. industry to evaluate and capitalize on near-term domestic and international opportunities for trough and power tower systems. Assist industry efforts to reduce the O&M and manufacturing costs of solar thermal systems. Provide support for the California Energy Commission Initiative for six renewable energy prison heating systems. 1998 - Assist U.S. industry to evaluate and capitalize on near-term domestic and international opportunities for trough and power tower systems. Assist industry efforts to reduce the O&M and manufacturing costs of solar thermal systems.	$900	$3,050	$1,630
TOTAL Solar Thermal Electric R&D - Power Applications Research	**$12,328**	**$13,800**	**$11,880**
TOTAL Solar Thermal Electric R&D	**$18,987**	**$22,250**	**$19,800**

SOLAR THERMAL ENERGY SYSTEMS (Cont'd)

Solar Industrial - Solar Detoxification	FY 1996	FY 1997	FY 1998
Solar Detoxification: 1996 - With ongoing technical assistance focused on efficiency improvements, the first commercial application of the photocatalytic oxidation process has been introduced by International Technology Corp. This application is likely to be the remediation of soil and groundwater contaminated from leaking fuel tanks. Field tests at refinery and electronics facilities were completed to show the effectiveness of the photocatalytic process in bringing industrial processes with environmental regulations. These experiments will assist International Technology and SolarChem in their efforts to commercialize the technology. 1997 - No activities planned. 1998 - No activities planned.	$2,777	$0	$0
TOTAL Solar Industrial - Solar Detoxification	**$2,777**	**$0**	**$0**
Solar Industrial - Solar Industrial Processes			
Solar Industrial Processes: 1996 - Cooperative solar process heat projects begun in FY95 have been completed. An industry-led team composed of solar manufacturers and their potential industrial and commercial customers will develop a strategy for making the technology suitable for targeted process heat markets. Cooperative research activities searching for new industrial applications of solar energy have been terminated. 1997 - No activities planned. 1998 - No activities planned.	$2,247	$0	$0
TOTAL Solar Industrial - Solar Industrial Processes	**$2,247**	**$0**	**$0**
TOTAL Solar Industrial Processes	**$5,024**	**$0**	**$0**

TOTAL Solar Thermal Electric R&D	**$18,987**	**$22,250**	**$19,800**
TOTAL Solar Industrial	**$5,024**	**$0**	**$0**
TOTAL Solar Thermal Energy Systems	**$24,011**	**$22,250**	**$19,800**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Thermal Systems Research: The decrease of $530,000 will reduce follow-on R&D for one concentrator system and reduce investment in developing durable polymer optical materials. (-$530,000)

Power Application Research: This decrease of $1,920,000 includes: (-$1,920,000)

Dish/Engine Development - The decrease of $480,000 would result in the slow down of our newly initiated dish/engine contracts. This would jeopardize efforts to add a second major supplier of critical dish/engine components, in response to industry's needs.

Power Tower Development - Due to funding limitations and startup problems in FY97, DOE's cost-share in FY98 shows a $30,000 increase in order to match non-DOE contributions.

SolMaT- The decrease of $50,000 reflects essentially level funding.

Systems and Market/Industrial Assistance - The decrease of $1,420,000 will result in the early termination of industrial sub-contracts and cancellation of collaborative activities with state energy offices. Projects developing new technologies for solar heat and electric demand-side management (solar air-conditioning) and advanced solar heating systems and manufacturing processes for new markets, will not be implemented.

Solar Detoxification: No Change. ($0)

Solar Industrial Process: No Change. ($0)

(-2,450,000)

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS

I. Mission Supporting Goals and Objectives: Biomass energy can provide products for three major world markets: electric power, transportation fuels, and chemicals/textiles, and has the potential to provide approximately 33% of the total U.S. energy needs in these markets. The mission of the Biopower/Biofuels Energy Systems Program is to assist U.S. industry in developing the technology base necessary for deploying cost-competitive renewable biomass energy systems capable of capturing these market opportunities. Biomass feedstocks consist of a wide range of plant-based matter, including agricultural residues and forestry wastes (such as rice straw/husks and sawdust), and trees and grasses grown specifically for their energy content (also known as dedicated energy feedstocks). Because of their renewable nature, biomass energy systems provide substantial environmental benefits -- as bioenergy crops absorb carbon during growth, their use for transportation fuels or electricity generation results in near zero net carbon release. When these fuels are used to displace traditional fossil fuels, significant emission reductions of the oxides of sulfur and nitrogen (SOx and NOx) can also be achieved. In addition, since biomass is domestically produced and is renewable, it offers significant opportunities for job creation, rural economic development, and alternative crop production opportunities for farmers (which can result in a further reduction of federal agricultural subsidy payments).

The goal of the Biopower/Biofuels Energy Systems program is to develop low-cost biomass energy feedstocks and cost competitive, high efficiency conversion technologies for power generation and liquid fuel and chemical markets, and to increase biofuels and biopower production capabilities. The program includes integrated activities from DOE's utility, industry, and transportation sectors.

BIOPOWER ENERGY SYSTEMS - UTILITIES

The mission of the Biopower Program is to encourage and assist the development and validation of renewable, biomass-based electricity generation systems which are capable of providing substantial economic and environmental benefits to the nation. The goals of the program are to: (1) advance the state-of-the-technology to a point where integrated biomass power systems (systems that integrate the production of high yielding feedstocks with advanced power conversion technologies) are cost-competitive with conventional fossil-fuel options, (2) enable an advanced turbine system to be adaptable to biomass-derived fuels, (3) develop systems capable of capturing emerging opportunities in international markets, and (4) support industry efforts to demonstrate these technologies through highly leveraged, cost-shared projects.

Biomass power is an attractive renewable electricity option for several reasons: 1) it is available upon demand for high-value baseload and intermediate-load power generation applications; 2) it can serve as a vital economic stimulus and create jobs in rural America through the creation of markets for renewable "home-grown" energy crops; and 3) it provides significant environmental benefits and ecological diversification. In order to capture these opportunities and to produce electricity from biomass in a cost-competitive manner, the Biopower

I. Mission Supporting Goals and Objectives (Cont'd):

Program promotes critical biomass power research, development, and proof-of-concept activities. The Program's primary efforts focus on validating next-generation biomass gasification/gas turbine systems, and on coupling high efficiency conversion technologies with dedicated feedstock production at first-of-a-kind integrated project sites.

Specific program goals include conducting the necessary research and development activities which will enable integrated biomass power systems to produce electricity for 4-1/2 to 5 cents/kilowatt-hour (the current cost is 7-9 cents/kilowatt-hour). Cost-shared gasification research is being conducted with industry partners and is aimed at capturing near-term domestic and international opportunities in this highly competitive market. The collaborative DOE/USDA "Biomass Power for Rural Development" initiative provides for cofiring, gasification and/or direct combustion cost-shared project opportunities with both agriculturally-based consortia and other key industry partners (including the pulp-and-paper industry). Research and analysis relating to restructuring in the electric utility industry will be conducted on issues associated with integration of biomass power systems into an increasingly competitive industry framework, and fundamental research on resource characteristics will also identify cost-competitive options for systems integration. Additionally, modular systems development activities for small-scale systems (200 kW to 1 MW) will be undertaken to ensure a competitive U.S. industry presence in this growing market opportunity.

The goal of the Advanced Turbine Systems (ATS)/Biomass for Cogeneration project is to allow biomass derived fuels to be burned in a combustion turbine. Switching from clean natural gas to biomass fuels in combustion turbines is a significant challenge. The biomass derived fuels contain corrosive species which rapidly degrade gas turbine performance. Cogeneration is the efficient production of two forms of energy (electricity and steam) from the same fuel source using the exhaust from one system as the input for the other. Cogeneration system efficiencies can reach as high as 80%, a significant improvement over 35% efficiency when the production of steam and electricity are separated. To reach the goal requires development in two critical areas: gas clean-up and ruggedizing the turbine to improve corrosion and erosion resistance.

A. Estimates of Benefits

The currently installed domestic biomass power generating capacity stands at approximately 7,000 MW. It is expected that by 2000, up to an additional 2,000 MW of biomass power systems will be installed. By 2010, it is predicted that 8,000 MW of new biomass power capacity will be added, growing to a total of 30,000 MW of newly installed capacity by 2020. This growth will be experienced in several market segments, including biomass cofiring at existing coal-fired facilities, greatly increased energy export from repowering within the pulp and paper industry, new integrated biomass power system deployments in rural areas aimed at capturing crucial economic and environmental benefits afforded by these systems, and deployments of smaller-scale, modular biopower systems in the international marketplace. This dramatic growth will be

I. Mission Supporting Goals and Objectives (Cont'd):

facilitated by the development and demonstration of high-efficiency, advanced technology biomass power systems which will be achieved in the first decade of the next century. The following table summarizes the program's benefits; these are cumulative benefits assuming a baseline of zero in 1996:

Metric	2000	2010	2020
Annual Primary Energy Displaced (Quads)	0.09	0.43	1.86
Annual Displaced Electricity Value ($M @ $0.07/kWh)	$630	$3,039	$13,026
Carbon Equivalent Emissions Reductions (MMTons)	2.03	8.91	36.62

An ATS/Biomass for Cogeneration system will be more cost-effective, more efficient, and environmentally cleaner than a conventional biomass-fueled power generation system. Cogeneration system efficiencies can reach as high as 90%. The following benefits are estimated from Biomass for Cogeneration; these are cumulative benefits assuming a baseline of zero in 1996:

Metric	2000	2010	2020
Total Primary Energy Displaced (Trillion Btus)	.23	1.07	1.28
Energy Cost Savings ($B)	.03	0.1	0.3
Carbon Reduction (MMTons)	1	2	2

I. Mission Supporting Goals and Objectives (Cont'd):

B. Performance Measures

Research and development advances sponsored by the Biopower Program will be incorporated into biomass electric conversion technologies enabling cost-competitive electricity production using dedicated energy feedstocks by 2004. Biomass for Cogeneration will demonstrate a combustion turbine that will be adaptable to biomass-derived fuels in 2000.

BIOFUELS ENERGY SYSTEMS - TRANSPORTATION

The Biofuels Program is a key component in achieving the Department's goal of reducing dependence on imported oil in the transportation sector by displacement with fuels produced from renewable domestic resources. The development of a major biofuels industry will create domestic jobs in agribusiness, engineering, lending institutions, construction, fuel production, and distribution. Biofuels will revitalize the nation's rural economies by providing more farm jobs, increased equipment sales, fuel plant employment, and other indirect employment and income benefits. Since biofuels burn cleanly, they are an excellent method for reducing emissions from the transportation sector. The use of biomass-based liquid transportation fuels result in little or no net additions of carbon dioxide, a major greenhouse gas, to the atmosphere.

Biofuels research, development and demonstration activities focus on integrated biomass feedstock production and conversion systems for the production of ethanol. Specifically, in the near term, major program activities include research and technology development to produce ethanol from waste materials, such as corn fiber and forestry waste, to be blended into gasoline for oxygenated fuel markets. The near-term use of waste feedstocks can expand the current starch-based ethanol industry, serving as a logical transition from starch to cellulose feedstocks. In the mid to long term, commercially viable energy crops, such as hybrid poplar and switchgrass which are under development by the program, will be used to produce ethanol for use in alternative fuel vehicles. Since diesel fuel is a predominant highway fuel, the program is also exploring opportunities with industrial partners and other Federal, State, and local agencies to expand the production and use of biodiesel in niche markets, in particular where environmental considerations are a major concern.

The Regional Biomass Energy Program will have a significant role in an aggressive plan for the deployment of biomass-based technologies. The program, through its local and regional contacts, will transfer current and reliable information on biomass development activities to potential users; this includes economic and technical information, as well as State and local regulatory, environmental, and market considerations.

A. Estimates of Benefits

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

I. Mission Supporting Goals and Objectives (Cont'd):

Metric	1996	2000	2010	2020
Primary Energy Displaced (Quads)	0	0.03	0.87	1.27
Primary Oil Displaced (MBPD)	0	0.01	0.41	0.60
Energy Cost Savings ($B)	0	0	0.1	1.1
Carbon Reductions (MMTons)	0	1	16	19

B. Performance Measures

The Biofuels Program has established ethanol production cost goals that drive research and technology development activities, and are related to the performance measures listed below. By the year 2000, the goal is to demonstrate technologies, in collaboration with industry partners, capable of producing ethanol from low-cost cellulosic waste materials at a cost of $0.90 per gallon, using biochemical conversion technology. By 2010, the goal is to produce ethanol in production volume plants at a cost of $0.67 per gallon from energy crops, and by 2020, to produce ethanol at a cost of $0.60 per gallon. The production cost goals are shown in the following table:

Cost Parameters
Biofuels-Transportation

	1985	1996	1997	1998	2000	2010	2020
Ethanol cost $/gallon*	3.80	1.22	1.20	1.13	0.90	0.67	0.60

*Based on feedstock cost of $2.00/MMBTU

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
Biopower Energy Systems - Utilities					
Thermochemical Conversion	$ 2,101	$ 1,435	$ 2,815	$ 1,380	96%
Systems Development	18,227	18,540	30,685	12,145	66%
Biomass for Cogeneration	1,130	4,000	3,000	-1,000	-25%
Municipal Solid Waste	1,760	0	0	0	0%
Feedstock Production	0	2,100	0	-2,100	-100%
Regional Biomass Energy Program	0	1,575	0	-1,575	-100%
Total Biopower Energy Systems	$ 23,218	$ 27,650	$ 36,500	$ 8,850	32%
Biofuels Energy Systems - Transportation					
Ethanol Production	$ 19,094	$ 22,750	$ 30,040	$ 7,290	32%
Biodiesel Production	300	750	1,000	250	33%
Feedstock Production	5,005	2,500	6,000	3,500	140%
Regional Biomass Energy Program	3,806	1,650	3,000	1,350	82%
Thermochemical Conversion	1,775	0	0	0	0%
Total Biofuels Energy Systems	$ 29,980	$ 27,650	$ 40,040	$ 12,390	45%
Total, Biopower/Biofuels Energy Systems	**$ 53,198**	**$ 55,300**	**$ 76,540**	**$ 21,240**	**38%**

III. Performance Summary - Accomplishments:

Biopower Energy Systems - Utilities - Thermochemical Conversion	**FY 1996**	**FY 1997**	**FY 1998**
1996 - Established partnership with fuel cell manufacturer (ERC) and performed preliminary system integration and efficiency analysis; identified potential markets and efficiency of simple fuel cell systems; identified parameters for de-coupled gasification/fuel cell testing at NREL and ERC. Completed construction of photoionization, time-of-flight mass spectrometer for the study of biomass gasification; screened coal-biomass and MSW-biomass blends with implications for cofiring applications. Substantially increased stability of biocrude oils through addition of inexpensive organic liquids. 1997 - Complete de-coupled testing and establish cleanup requirements and confirm simple cycle efficiencies for gasification/fuel cell systems; complete market assessment for biomass gasifier/fuel cell systems; investigate biomass gasification using time-of-flight mass spectrometer; continue investigation of coal/biomass blend combustion with respect to alkali release and pollutant formation, coordinate results and efforts with Fossil Energy programs; continue investigation of alkali and nitrogen chemistry as it relates to biomass combustion. 1998 - Perform integrated testing of 20kW fuel cell at an appropriate facility. Begin preparations for MW-class, biomass powered fuel cell demonstration. Continue detailed analytical investigations in support of industry-related biomass combustion/cofiring and gasification activities in collaboration with other government laboratories. Initiate efforts for developing efficient energy feedstock handling systems, to cover harvesting techniques and injection systems for a wide range of feedstock types.	$2,101	$1,435	$2,815
TOTAL Biopower Energy Systems - Utilities - Thermochemical Conversion	**$2,101**	**$1,435**	**$2,815**

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biopower Energy Systems - Utilities - Systems Development	FY 1996	FY 1997	FY 1998
Climate Change Action Plan- **Hawaii Direct Gasifier Project:** 1996-Completed Phase I long-duration testing of the gasifier. 1997-Complete 500 hr and 1000 hr full capacity runs at facility to complete full system operational testing and incorporate a full-scale Hot-Gas Cleanup unit into the facility. 1998-Initiate construction on a commercial-scale facility thru a cost-shared venture with a private sector partner. Total project costs are estimated to be $12.5 M, with industry cost-sharing 50-70% of the total development costs.	$3,932	$4,096	$6,222
Climate Change Action Plan- **Vermont Indirect Gasifier Project:** 1996-Continued construction of the commercial-scale gasifier installation. 1997-Complete Phase II of the project, which includes construction, operational testing of the gasifier, and conducting output gas analysis. 1998-Complete the project (Phase III), which includes installation of a commercially available gas turbine, and conducting integrated testing/operation of the gasifier/gas turbine configuration, leading to commercial operation. This phase will secure the remaining private-sector investment/cost-share of over $9M.	$8,346	$5,393	$645
Climate Change Action Plan- **Biomass Power for Rural Development Initiative (New York Willow Project, Iowa Switchgrass Project, Minnesota Valley Alfalfa Producers Project, Whole Tree Energy Project):** 1996-Awarded 4 integrated biomass power projects through this joint initiative with USDA. These projects will demonstrate the viability of generating electricity from dedicated energy crops through integrated, high-efficiency biopower conversion technologies.			

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biopower Energy Systems - Utilities - Systems Development (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
Climate Change Action Plan- **Biomass Power for Rural Development Initiative (New York Willow Project, Iowa Switchgrass Project, Minnesota Valley Alfalfa Producers Project, Whole Tree Energy Project) (Cont'd)**: 1997-Complete Phase I (detail design engineering and permitting) and initiate establishment of dedicated energy crop supplies for at least three of these integrated biopower facilities. Power plant modifications for energy crop utilization will be initiated at two cofiring project sites. 1998-Facility construction and energy crop establishment will continue (total biopower capacity at these project sites will exceed 150 MW). Cofiring tests of willow energy crops with coal in a commercial application will be accomplished.	$5,949	$9,051	$19,818
Modular Systems Development: 1996-No Activity 1997-No Activity 1998-Building on advancements achieved through prior year thermochemical conversion development research in this area, initiate efforts with U.S. industry aimed at developing modular (200kW -1 MW) biopower systems for distributed generation and remote power applications. Development of smaller biopowered systems (such as Stirling engines and fuel cells) will promote U.S. industry capture of rapidly expanding global market opportunities.	$0	$0	$4,000
TOTAL Biopower Energy Systems - Utilities - Systems Development	**$18,227**	**$18,540**	**$30,685**

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biopower Energy Systems - Utilities - Biomass for Cogeneration	**FY 1996**	**FY 1997**	**FY 1998**
ATS/Biomass for Cogeneration: 1996 - Completed 2 studies on converting combustion turbines from natural gas to biomass; initiated development of thermal barrier coatings and improved airfoil castings that will have increased corrosion resistance, cost, life, and ease of fabrication; initiated studies into the requirements for development of gas clean-up systems. 1997 - Continue development of thermal barrier coatings and improved airfoil castings. 1998 - Continue design and testing of combustion turbine components	$1,130	$4,000	$3,000
TOTAL Biopower Energy Systems - Utilities - Biomass for Cogeneration	**$1,130**	**$4,000**	**$3,000**
Biopower Energy Systems - Utilities - Municipal Solid Waste			
1996 - Completed construction of the high solids anaerobic digester in California. Began operation and evaluation of the digester. Successful demonstration will lead to the commercialization of the high solids technology, producing a clean burning fuel gas for electricity production. Compiled data and developed guidance document on the beneficial use of combustion ash. This will provide a technical basis for the increased use of the ash and result in reducing costs associated with recovery of energy from waste and other materials (i.e. paper, plastic, and wood) and assist State and local governments in meeting mandatory waste diversion rates by diverting the materials from landfills. All other tasks were terminated. 1997 - Complete pilot plant operation of the high solids anaerobic digester in California, with funds obligated prior to FY 1997. Completion of this activity will terminate the MSW program.	$1,760	$0	$0
TOTAL Biopower Energy Systems - Utilities - Municipal Solid Waste	**$1,760**	**$0**	**$0**

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biopower Energy Systems - Utilities - Feedstock Production	**FY 1996**	**FY 1997**	**FY 1998**
1996 - Funding for this activity was provided through the Biofuels-Transportation program. 1997 - Feedstock production research in FY 1997 is co-funded by Biopower-Utilities and Biofuels-Transportation in accordance with Congressional report language. Activities for FY 1996 through FY 1998 support a core program that is designed to meet the needs of both programs. Since this core program is managed by Biofuels-Transportation, the program activity description is contained in that request. 1998 - The full funding request for this activity is contained within the Biofuels-Transportation budget, which manages this activity.	$0	$2,100	$0
TOTAL Biopower Energy Systems - Utilities - Feedstock Production	**$0**	**$2,100**	**$0**
Biopower Energy Systems - Utilities - Regional Biomass Energy Program			
1996 - Funding for this activity was provided through the Biofuels-Transportation program. 1997 - Regional Biomass Energy Program activities in FY 1997 are co-funded by Biopower-Utilities and Biofuels-Transportation in accordance with Congressional report language. Activities for FY 1996 through FY 1998 support a core program that is designed to meet the needs of both programs. Since this core program is managed by Biofuels-Transportation, the program activity description is contained in that request. 1998 - The full funding request for this program is contained within the Biofuels-Transportation budget, which manages this activity.	$0	$1,575	$0
TOTAL Biopower Energy Systems - Utilities - Regional Biomass Energy Program	**$0**	**$1,575**	**$0**
TOTAL Biopower Energy Systems - Utilities	**$23,218**	**$27,650**	**$36,500**

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biofuels Energy Systems - Transportation - Ethanol Production	FY 1996	FY 1997	FY 1998
Advanced Fermentation Organisms R&D: 1996, 1997, and 1998-Conduct research and development of advanced fermentation organisms to improve process efficiency, including the development of **Zymononas Mobilis** with enhanced capabilities.	$2,394	$2,000	$2,000
Advanced Cellulases R&D: 1996 and 1997-Conduct research and development of advanced engineered cellulases and expression systems, including but not limited to genetic engineering of **Streptomyces lividans** to produce the third cellulase enzyme, leading to the development of an artificial cellulase system. 1998-Continue R&D and establish 1-2 partnerships with cellulase producers to develop highly productive, low-cost cellulase systems.	$2,500	$2,110	$4,200
Pretreatment R&D: 1996 and 1997-Continue to evaluate and develop pretreatment techniques specific to feedstocks of interest to industrial partners. 1997-Complete design and initiate scale-up of an advanced pretreatment reactor with an industrial partner. 1998-Incorporate/modify the National Renewable Energy Laboratory process development unit (PDU) to include the advanced pretreatment reactor.	$1,750	$2,500	$2,000
Consortium for Plant Biotechnology Research: 1996, 1997, and 1998-Conduct 50:50 cost-shared, long term R&D projects with the Consortium for Plant Biotechnology Research, which provides high-quality, peer-reviewed university research with practical application to biofuels development.	$1,100	$1,100	$1,000

Biofuels Energy Systems - Transportation - Ethanol Production (Cont'd)	FY 1996	FY 1997	FY 1998
Integrated Process Development: 1996-Completed pilot-scale tests with Amoco Corporation to provide reliable scale-up operational and cost data for demonstration and small commercial facilities. 1996, 1997, and 1998-Conduct integrated bench-scale studies to evaluate and optimize unit operations, such as detoxification studies to improve the overall process. 1997 and 1998-Operate the NREL process development unit (PDU) in a fully integrated mode (feedstock to ethanol) with one or more partners, testing all unit operations (handling, pretreatment, fermentation) to evaluate process efficiency and costs for agricultural waste feedstocks, such as rice straw; and test forestry wastes at the NREL biofuels user facility/PDU. 1998-Validate at the bench scale the performance of a genetically improved fermentation organism capable of fermenting all available cellulosic biomass sugars.	$8,200	$8,610	$8,840
Feasibility Studies: 1996, 1997, and 1998-Provide technical and financial support for feasibility studies/business plans with industrial partners for biomass-to-ethanol production facilities.	$2,500	$1,430	$1,000
Cellulose-to-Ethanol Production Facilities: Laying the groundwork for a broad based cellulosic biomass-to-ethanol industry, develop cost-shared partnerships to design and construct ethanol production facilities. 1996-Established one new partnership for waste-to-ethanol facility. The partnership is the Gridley Rice Straw Project which involves prefeasibility research designed to lead to a demonstration plant. The DOE share is $650,000 and the non-Federal partner is the Stone and Webster Team which provided $130,000.			

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biofuels Energy Systems - Transportation - Ethanol Production (Cont'd)	FY 1996	FY 1997	FY 1998
Cellulose-to-Ethanol Production Facilities (Cont'd): 1997-Establish one additional partnership for waste-to-ethanol facility, BC International (sugarcane bagasse waste in Louisiana) with the DOE share $2,000,000 and BCI projected to provide $6,200,000 or 76% cost share. Also, the Gridley Rice Straw project will continue with DOE planning to provide $3,000,000 for the Gridley project as directed in Congressional Appropriations Report language. Gridley will be a 50% cost-shared facility for a rice straw demonstration facility. In related project work, a Phase I, pre-feasibility project, is near completion. Phase II, Process Demonstration Unit (PDU) testing, has been approved by the California Energy Commission who will provide $165,000 towards this stage of the project. 1998-Obtain 1-3 additional commitments to design and construct biomass waste to ethanol facilities. BC International will complete funding for the project that was initiated in FY 1997. DOE's share in FY 1998 is planned at $4,000,000 with BCI cost-share of $27,600,000 or an 87% cost-share. The additional 1-3 commitments is expected to come from a number of companies/waste opportunities including Swan Biomass Company, Arkenol, Quincy Library Group, and Masada Resources Group. A minimum 50% cost share will be required from these sources.	$650	$5,000	$11,000
TOTAL Biofuels Energy Systems - Transportation - Ethanol Production	**$19,094**	**$22,750**	**$30,040**
Biofuels Energy Systems - Transportation - Biodiesel Production			
Alternative Production Technologies: 1996-Initiate an evaluation of alternative production technologies to determine potential methods for lowering production costs. 1997 and 1998-Based on this assessment, identify and implement strategies for improving the potential of biodiesel.	$300	$550	$800
Waste Oil Assessment: 1997 and 1998-Conduct an evaluation of the quantity, availability, and potential of waste oils as a transportation fuel.	$0	$200	$200
TOTAL Biofuels Energy Systems - Transportation - Biodiesel Production	**$300**	**$750**	**$1,000**

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biofuels Energy Systems - Transportation - Feedstock Production *	FY 1996	FY 1997	FY 1998
Biomass Feedstock Development Centers: 1996, 1997, and 1998-Conduct research to develop economically viable model energy crops at integrated biomass feedstock development centers in the Pacific Northwest (poplars), Southeast (switchgrass), and Midwest/Plains States (switchgrass and poplars). 1997 and 1998-Conduct research to develop willow as a viable energy crop in the Northeast/Lake States.	$3,105	$3,300	$3,500
Switchgrass/Ethanol Facilities Location Studies: 1996-Identified locations in the Midwest and the South capable of supplying low-cost switchgrass at various demand levels. 1997-Based on this analysis, determine the number of ethanol facilities that can be supported in these locations.	$150	$100	$0
Environmental Effects of Energy Crop Deployment: 1996, 1997, and 1998-Conduct research to evaluate the effects of large scale deployment of energy crops on the environment, and to provide credible data that can be used to guide deployment in a manner that ensures energy and environmental benefits.	$500	$500	$500
Energy Crop Seedling/Planting Stock Selection Research: 1996, 1997, and 1998-Using advanced biotechnology and other methods, identify techniques that can be used to select energy crop seedlings or other planting stock that are less susceptible to disease and/or pest reducing the risk of mortality and increasing technical/economic viability.	$500	$300	$300
Large Scale Woody Crop Plantation Research: 1996-Established research plantings in partnership with a major paper company, for use in identifying physiological constraints to woody crop growth in the Southeast. 1997 and 1998-Continue research and evaluate management techniques to overcome these constraints in the Southeast.			

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biofuels Energy Systems - Transportation - Feedstock Production (Cont'd)*	**FY 1996**	**FY 1997**	**FY 1998**
Large Scale Woody Crop Plantation Research (Cont'd): 1998-Provide technical assistance and cost sharing for large scale plantings in the Midwest/North Central region to obtain performance and cost data.	$150	$150	$500
Switchgrass Variety Testing and Scale-up Research: 1997-Establish new switchgrass variety tests in locations that have been identified as having high potential for technical and economic viability of these crops, but where very little data currently exist to develop the best clones or varieties specifically adapted to the variable conditions in the major growing regions of the U.S. 1998-Continue variety tests and initiate cost-shared 1,000-2,000 acre scale-up plantings of switchgrass in the Midwest or South to obtain yield, operational and costs data.	$0	$200	$700
Mechanization Research: 1996-Established a mechanization steering committee composed of industry and other interested stakeholders. 1997 and 1998-Based on committee recommendations for research and collaborative interests, conduct cost-shared research and development of mechanization systems for energy crops to lower harvesting/handling cost, a major obstacle to the widespread use of energy crops.	$100	$50	$500
Aquatic Crops Research: **1996-Terminated aquatic Crop research.**	$500	$0	$0
TOTAL Biofuels Energy Systems - Transportation - Feedstock Production	**$5,005**	**$2,500***	**$6,000**

* Feedstock production research in FY 1997 is co-funded by Biopower-Utilities and Biofuels-Transportation in accordance with Congressional report language. Activities for FY 1996 through FY 1998 support a core program that is designed to meet the needs of both programs. Total Feedstock Production funding: $2,100,000 + $2,500,000 = $4,600,000. See crosscut schedule below.

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Biofuels Energy Systems - Transportation - Regional Biomass Energy Program *	FY 1996	FY 1997	FY 1998
Regional Biomass Resource Activities: 1996, 1997, and 1998-Continue regionally-focused activities with State and local governments and industry to develop capability to produce and use biomass resources.	$3,806	$3,225	$1,650
Biofuels Production Facilities Siting Activities: Using the regional program infrastructure, provide support for cost-shared site studies for biofuels production facilities, including resource assessments and analyses of local, State, and regional nontechnical issues.	$0	$0	$1,350
TOTAL Biofuels Energy Systems - Transportation - Regional Biomass Energy Program	**$3,806**	**$1,650***	**$3,000**

* Regional Biomass Energy Program activities in FY 1997 are co-funded by Biopower-Utilities and Biofuels-Transportation in accordance with Congressional report language. Activities for FY 1996 through FY 1998 support a core program that is designed to meet the needs of both programs. Total Regional Biomass Energy Program funding: $1,575,000 + $1,650,000 = $3,225,000. See crosscut schedule below.

Biofuels Energy Systems - Transportation - Thermochemical Conversion	FY 1996	FY 1997	FY 1998
Thermochemical Conversion R&D: 1996-Terminated all research and development activities for the production of biomass-based transportation fuels, using thermochemical conversion processes.	$1,775	$0	$0
TOTAL Biofuels Energy Systems - Transportation - Thermochemical Conversion	**$1,775**	**$0**	**$0**
TOTAL Biopower Energy Systems - Utilities	**$23,218**	**$27,650**	**$36,500**
TOTAL Biofuels Energy Systems - Transportation	**$29,980**	**$27,650**	**$40,040**
TOTAL Biopower/Biofuels Energy Systems	**$53,198**	**$55,300**	**$76,540**

SOLAR AND RENEWABLE ENERGY

BIOPOWER/BIOFUELS ENERGY SYSTEMS (Cont'd)

Crosscutting Schedule:

Feedstock Production and Regional Biomass Energy Program

	FY 1996	FY 1997	FY 1998
Feedstock Production:			
Biopower Energy Systems - Utilities	$0	$2,100	$0
Biofuels Energy Systems - Transportation	$5,005	$2,500	$6,000
Total, Feedstock Production	$5,005	$4,600	$6,000
Regional Biomass Energy Program:			
Biopower Energy Systems - Utilities	$0	$1,575	$0
Biofuels Energy Systems - Transportation	$3,806	$1,650	$3,000
Total, Regional Biomass Energy Program	$3,806	$3,225	$3,000

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Thermochemical Conversion (Utilities): The increase of $1,380,000 is due to enhanced basic research in biomass combustion characteristics (especially relating to cofiring biomass with coal), enhanced research on biomass gasification/fuel cell development, and targeted. cost-shared efforts aimed at developing advanced energy feedstock handling systems, with a primary focus on improved methods of injecting biomass fuels into gasifiers and combustors. (+$1,380,000)

FUNDING CHANGES FROM FY 1997 TO FY 1998 (Cont'd):

Systems Development (Utilities): The increase of $12,145,000 is necessary to support the demonstration of advanced, cost-competitive, integrated biomass power projects being undertaken as part of the collaborative DOE/USDA "Biomass Power for Rural Development" initiative, including the New York Willow Project, the Iowa Switchgrass Project, and the Minnesota Valley Alfalfa Producers (MnVAP) Project. The federal investment in these projects (which will bring on-line over 150 MW of renewable biomass power) includes funding for construction and feedstock establishment costs, and will ultimately leverage over $200,000,000 of private sector investment. This funding is also for the initiation of cost-shared research on advanced modular biopower systems, including fuel cells and Stirling engines, for distributed generation and remote power applications.	(+$12,145,000)
Biomass for Cogeneration (Utilities): The decrease of $1,000,000 reduces support for the design, manufacture, and testing of combustion turbine components that will allow for conversion from natural gas to biomass gaseous fuels in cogeneration applications.	(-$1,000,000)
Municipal Solid Waste(Utilities): No change.	($0)
Feedstock Production (Utilities**):** Although this program is ongoing, the request for FY 1998 funding for the entire program is made under the Biofuels-Transportation section since this program is managed by Biofuels-Transportation.	(-$2,100,000)
Regional Biomass Energy Program (Utilities**):** Although this program is ongoing, the request for FY 1998 funding for the entire program is made under the Biofuels-Transportation section since this program is managed by Biofuels-Transportation.	(-$1,575,000)
Ethanol Production (Transportation): The increase of $7,290,000 is due to focussing on a strategy that will lay the groundwork for a broad based cellulosic biomass-to-ethanol industry, involving cost-shared partnerships for the design and construction of these first-of-a-kind cellulose-to- ethanol facilities ($6,000,000), integrated bench-scale/PDU studies ($230,000) and cost-shared partnerships to develop highly-productive, low cost cellulases ($2,090,000), while decreasing funds for mid-to long-term research (-$1,030,000).	(+$7,290,000)
Biodiesel Production (Transportation): The increase of $250,000 is due to implementing a strategy to improve the cost-effectiveness of biodiesel production.	(+$250,000)

FUNDING CHANGES FROM FY 1997 TO FY 1998 (Cont'd):

Feedstock Production (Transportation): The core program in FY 1997 is funded, in totality, at $4,600,000 with $2,100,000 from the Biopower program and $2,500,000 from the Biofuels program. In FY 1998, the request for the Biofuels portion is $6,000,000. The increase of $1,400,000 for the combined Biopower and Biofuels Feedstock program is due to cost-shared mechanization research to lower harvesting/handling costs of energy crops ($450,000), scale-up research plantings of switchgrass ($500,000) and hybrid poplar ($350,000), research to develop hybrid willow, an additional viable energy crop on certain sites/locations ($200,000), and the completion of the switchgrass/ethanol location studies (-$100,000).	(+$3,500,000)
Regional Biomass Energy Program (Transportation): The core program in FY 1997 is funded, in totality, at $3,225,000 with $1,575,000 from the Biopower program and $1,650,000 from the Biofuels program. In FY 1998, the request is for $3,000,000. The decrease of $225,000 reflects a reduction in the number of new cost-shared projects focussed on deploying biopower/biofuels technologies.	(+$1,350,000)
Thermochemical Conversion (Transportation): No change.	$0
	(+$21,240,000)

Solar and Renewable Energy
Biopower and Biofuels Energy Systems Funding
(Dollars in millions)

	FY 1996	FY 1997	FY 1998
DOE Funding	$53.2	$55.3	$76.5
U.S. Department of Agriculture	10.0	10.0	10.0
Total Funding	$63.2	$65.3	$86.5

SOLAR AND RENEWABLE ENERGY

WIND ENERGY SYSTEMS

I. Mission Supporting Goals and Objectives: The mission of the Wind Energy R&D Program is to establish wind energy as a regionally diversified, cost-effective power generation technology, through a coordinated research effort with industry and utilities that will minimize technical and institutional risks for U.S. companies competing in domestic and international markets.

Wind is an attractive energy source for several reasons: 1) wind generated electricity has the potential for serving as an inexpensive energy source for consumers and industries; 2) wind generated electricity produces no polluting emissions or other greenhouse gases; and 3) the international market for wind turbines is large and growing rapidly. In 1995, worldwide wind electric generating capacity increased by over 40 percent through the addition of 1400 MW, with sales valued at $1.5 billion. By 2000, sales of wind energy technologies in the world market are estimated to reach $2-3 billion each year. While the U.S. wind industry is beginning to establish a foothold in this market, European and Japanese manufacturers continue to aggressively develop advanced technology and are increasingly competitive.

The Wind Energy R&D program conducts its research and development efforts to help U.S. industry develop wind technology as an economically viable energy supply option and to gain a technological edge over international competition. In FY 1998, the program will focus on Applied Research, Turbine Research, and Cooperative Research and Testing. The Applied Research program addresses fundamental engineering and technology issues with a broad range of applications and is carried out at national laboratories and numerous universities. The Turbine Research program is a coordinated effort with industry and utilities which performs cost shared research to develop the next generation of wind turbines. The Cooperative Research and Testing program conducts R&D and prototype testing at the world class National Wind Technology Center in Colorado which features a new user facility that allows U.S. industries to expand testing of new wind energy technologies. These program elements complement the activities of the National Wind Coordinating Committee, a public/private partnership of producers, utilities, regulators, environmentalists and trade organizations.

The Wind Energy R&D program has been extraordinarily successful in bringing down the cost of wind-generated electricity from 35 cents per KWh in 1980, to 7 cents per KWh in 1989, and 4 cents per KWh (in 15 mph winds) today. At current costs and in selected markets, wind energy can be competitive with conventional energy sources on a life-cycle basis. Ultimately, wind energy will compete with gas- and coal-fired plants, which dominate the generation mix in the Midwestern U.S. where the majority of the country's good wind resource is located. To allow expansion of this large resource base, and to allow wind energy to be competitive in an era of utility restructuring that emphasizes low initial cost and independent power projects, significant improvements to the technology are still needed to reach the Program's goal of 2.5 cents per kWh in 15 mph winds by 2000.

As wind technology moves closer to full commercialization, the Wind Energy R&D program intends to increase the private sector's share of R&D and demonstration project costs. For example, Federal support for Turbine Research is expected to decrease after FY 2000 as wind

I. Mission Supporting Goals and Objectives (Cont'd):

technology becomes cost competitive with traditional power sources and as utilities and industry contribute an increasing percentage of funding for activities at the National Wind Technology Center (NWTC). These are cumulative benefits assuming a zero baseline in 1996.

A. Estimates of Benefits

	2000	2010	2020
Annual Primary Energy Displaced (Quads)	0.05 Q	0.28 Q	1.45 Q
Annual Displaced Electricity Value ($0.07/kWh)	$376 M	$1,991 M	$10,142 M
Carbon Equivalent Emissions Reductions	1.19 MMT	5.84 MMT	28.51 MMT
Direct Oil Displaced (million barrels)	0.69	2.1	7.74

Wind energy generating capacity installed in the U.S. currently totals over 1700 MW, is expected to grow to 2700 MW by 2000, and reach 10,000 MW by 2010. Wind energy emissions reduction impacts are enhanced by regional effects because much of the anticipated expansion will occur in the Midwest, where coal dominates the current generation mix.

B. Goals

The following performance measures will be used by the Wind Energy R&D Program to track its commitment to meeting its year 2000 goal of producing electricity from wind energy for 2.5 cents per kWh in 15 mph winds with favorable financing.

1996 Performance Measures

- Expanded Utility Wind Interest Group (UWIG) membership by 70% to 22, resulting in increased wind energy interest and deployment activities.

- Deployed advanced wind turbines capable of producing electricity at 5.0 cents per kWh in moderate winds.

I. Mission Supporting Goals and Objectives (Cont'd):

1997 Performance Measures

- New advanced technology wind turbine development projects are underway with six U.S. companies that will result in performance improvement of over 20% compared to current technology.
- Five additional U.S. utilities undertake new wind energy test and evaluation projects.

1998 Performance Measures

- Over 50 MW of cost-shared wind energy projects installed.
- First village power pilot project for domestic and international applications installed.

1999-2002 Performance Measures

- Advanced wind turbines deployed that are capable of producing electricity at 2.5 cents per kWh in 15 mph winds.
- 2700 MW of domestic installed capacity achieved.
- 25% of world wind energy market secured by U.S. industry.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
Applied Research	$ 9,900	$ 12,200	$ 14,100	$ 1,900	16%
Turbine Research	15,320	8,500	19,700	11,200	132%
Cooperative Research and Testing	6,200	8,300	9,058	758	9%
Total, Wind Energy Systems	**$ 31,420**	**$ 29,000**	**$ 42,858**	**$ 13,858**	**48%**

III. Performance Summary - Accomplishments:

Applied Research	FY 1996	FY 1997	FY 1998
Core Research: 1996 - Improved technology base for wind industry through research at the National laboratories in aerodynamics, wind characterization, structural dynamics, materials and fatigue, and completed design of a 1.5 megawatt dynamometer for turbine research testing activities at the National Wind Technology Center (NWTC). 1997 - Continue to improve technology base for wind industry through research at the National laboratories, and complete installation of the new Advanced Research Turbine test facility at the NWTC. 1998 - Continue to improve technology base for wind industry through research at the National laboratories, and complete 1.5 megawatt dynamometer facility construction and installation.	$5,850	$9,340	$10,000
University Research: 1996 - Awarded contracts to thirteen universities, including Historically Black Colleges and Universities (HBCU) and Hispanic Educational Institutions (HEI), for research on innovative wind technology concepts and to develop centers of wind energy research excellence in the U.S. 1997 - Continue research with twelve universities, and award two new HBCU contracts. 1998 - Continue research with twelve universities, and award new HBCU, HEI, and other university contracts.	$1,800	$1,200	$1,600
Wind Hybrid Systems: 1996 - Completed installation of a wind/hybrid system research test facility at the NWTC. 1997 - Complete design and testing of control system for wind/hybrid system for a high penetration village power application. 1998 - Complete research testing program of a new wind/hybrid power system, with an industrial partner, using the NWTC wind/hybrid test facility.	$750	$1,090	$2,000

SOLAR AND RENEWABLE ENERGY

WIND ENERGY SYSTEMS (Cont'd)

Applied Research (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
Avian Research: 1996 - Selected three projects under avian risk reduction studies solicitation. Publish proceedings of second research workshop. 1997 - Complete golden eagle population study and related avian modeling. 1998 - Complete avian risk reduction studies.	$1,500	$570	$500
TOTAL Applied Research	**$9,900**	**$12,200**	**$14,100**
Turbine Research			
Near-Term Research and Testing: 1996 - Using prior year funding, completed near-term turbine research and field testing, resulting in three highly competitive U.S. wind turbines that have already secured agreements for sales worth up to $200 million in domestic and international markets. Completed solicitation for product improvement project to enhance U.S. industry utility-scale wind turbines for near-term global markets. 1997 - Using prior year funding, award three to five cost shared contracts under product improvement project. 1998 - Complete final designs for product improvement project turbines and begin prototype fabrication.	$1,000	$0	$4,000
Next Generation Turbine Project: 1996 - Completed field tests for advanced turbine components and subsystems including a variable-speed generation system, advanced distributed monitoring system, and an enhanced rotor design, for use in next-generation wind turbine research efforts. Selected two companies to design and develop innovative next generation wind turbines that will significantly reduce the cost of wind generated electricity.			

SOLAR AND RENEWABLE ENERGY

WIND ENERGY SYSTEMS (Cont'd)

Turbine Research (Cont'd)	FY 1996	FY 1997	FY 1998
Next Generation Turbine Project (Cont'd): 1997 - Using prior year funding, complete design and initiate fabrication of proof-of-concept turbines under the continuing next-generation turbine development project. 1998 - Complete proof-of-concept testing and begin fabrication of full scale next generation wind turbine prototypes. (Industry cost-share contribution is $4,000)	$5,840	$0	$9,000
Small Wind Turbine Project: 1996 - Using prior year funding, completed solicitation for U.S. industry partners to develop highly reliable, cost effective small wind turbines. 1997 - Using prior year funding, award four contracts and begin work under the small wind turbine project. 1998 - Complete fabrication of proof-of-concept wind turbines under the small wind turbine project, and begin field testing.	$0	$0	$1,460
Supporting Research, Testing, and Management: 1996 - Provided testing, design review, analysis, and management support for 12 industry subcontract projects, and completed critical blade structural testing for four U.S. industry wind turbines. 1997 - Provide testing, design review, analysis, and management support for 18 industry subcontract projects. 1998 - Provide testing, design review, analysis, and management support for 11 industry subcontract projects.	$8,480	$8,500	$5,240
TOTAL Turbine Research	**$15,320**	**$8,500**	**$19,700**

Cooperative Research and Testing	FY 1996	FY 1997	FY 1998
Industry Support: 1996 - Assisted U.S. industry in the design, development, testing, and analysis of solutions to current operational and institutional challenges using the facilities at the NWTC, and completed testing of a wind powered icemaking system with widespread international applications. 1997 - Assist U.S. industry using the facilities at the NWTC, and in accordance with Congressional direction, provide support for the Kotzebue, Alaska wind farm development project. 1998 - Assist U.S. industry using the facilities at the NWTC, and complete resource assessment and prefeasibility study for wind/hybrid mini-grid project in a developing country.	$3,050	$3,850	$4,358
Certification and Standards: 1996 - Performed first wind turbine certification tests for U.S. industry. 1997 - Complete wind turbine structural loads, electrical, and component certification testing procedures to conform to existing international standards. 1998 - Complete requirements for International Standards Organization accreditation for wind turbine certification testing at the National Wind Technology Center.	$700	$1,500	$2,000
Utility Analysis: 1996 - Completed utility case study of wind energy capacity valuation and risk impacts. 1997 - Complete acquisition of wind resource data collected by Utility Wind Interest Group participants and initiate wind utility value analysis project with competitively selected stakeholders. 1998 - Complete wind utility value analysis project, allowing promotion of specific high value domestic electric market segment opportunities for wind energy.	$1,200	$1,450	$1,400

Cooperative Research and Testing (Cont'd)			
National Wind Technology Center Operations: 1996 - Provided support for advanced research projects and testing, and with prior year funding, supported completion of the new Industrial User Facility that will provide state-of-the-art research facilities for industry's use on a reimbursable basis. 1997 - Provide support for advanced research projects and testing, and complete site road and electrical system upgrades needed for additional research turbines. 1998 - Provide support for advanced research projects and testing.	$1,250	$1,500	$1,300
TOTAL Cooperative Research and Testing	**$6,200**	**$8,300**	**$9,058**
TOTAL Wind Energy R&D	**$31,420**	**$29,000**	**$42,858**

***FUNDING CHANGES FROM FY 1997 TO FY 1998*:**

Applied Research: The increase of $1,900,000 is required to support planned increases for core research activities, university research, and hybrid systems programs. (+$1,900,000)

Turbine Research: The increase of $11,200,000 is required to support ongoing subcontracts that were funded in 1997 with prior year funds. In FY 1998 final designs will be completed and prototype fabrication will begin under 5 cost-shared contracts; final proof of concept vesting will be completed and fabrication will commence on next generation wind turbine prototypes; and field testing will begin on the small wind turbine project. (+$11,200,000)

Cooperative Research and Testing: The increase of $758,000 provides additional support for industry testing at the National Wind Technology Center, and expanded certification and standards program activities. (+$758,000)

(+$13,858,000)

SOLAR AND RENEWABLE ENERGY

RENEWABLE ENERGY PRODUCTION INCENTIVE PROGRAM

I. Mission Supporting Goals and Objectives: The Renewable Energy Production Incentive (REPI) is part of an integrated strategy contained in the Energy Policy Act of 1992 to promote increases in the generation and utilization of electricity from renewable energy sources and to further the advances of renewable energy technologies. Under this program, annual appropriations provide financial incentives to new (operations started October 1, 1993 or later) qualified renewable energy facilities owned by State entities, municipal utilities, and electric cooperatives for the production of electricity. For these tax-exempt owners of new renewable energy generation units, REPI will provide financial incentives that are comparable to the value of the production tax credits for investor-owned renewable energy generators and the investment tax credits for non-utility investors in certain renewable energy generation technologies.

A. Estimate of Benefits

The REPI program has provided incentive for the construction of 11 new renewable energy facilities, which generated over 150 million kilowatt-hours of electricity in Fiscal Year 1995.

B. Goals

FY 1996 Performance Measures

- A preliminary review of applications reveals that approximately 180 million kWh was produced as a result of this program in FY 1996.

FY 1997 Performance Measures

- It is expected that 220 million kWh will be produced as a result of this program in FY 1997.

FY 1998-2000 Performance Measures

- The program is expected to produce steady increases in renewable energy output, exceeding 350 million kWh in the year 2000.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
REPI	$ 0	$ 2,000	$ 4,000	$ 2,000	100%
Total, Renewable Energy Production Incentive Program	**$ 0**	**$ 2,000**	**$ 4,000**	**$ 2,000**	**100%**

III. Performance Summary - Accomplishments:

Renewable Energy Production Incentive Program	FY 1996	FY 1997	FY 1998
1996 - Provided electricity production incentive payments to qualified participants; reviewed existing rule and developed clarifications to avoid ambiguities. *			
1997 - Provide electricity production incentive payments to qualified participants; publish rule clarification; develop and analyze options to increase the effectiveness of the REPI program without adding significantly to its cost.			
1998 - Provide electricity production incentive payments to qualified participants.	$0	$2,000	$4,000
TOTAL Renewable Energy Production Incentive Program	**$0**	**$2,000**	**$4,000**

***** In FY 1996 this activity was funded in the Solar Program Support line (FY 1996/$658).

FUNDING CHANGES FROM FY 1997 TO FY 1998:

REPI: The increase of $ 2,000,000 reflects the estimated increased production from qualified renewable generation units that are scheduled to start operations and the inflation adjustment for the rate that is applied to calculate the production incentive payments. Since the FY 1997 appropriation is anticipated to provide for only partial production incentive payments for some qualified new renewable energy facilities, this increase will also be used to address this prior-year payment shortfall. (+$2,000,000)

SOLAR AND RENEWABLE ENERGY

INTERNATIONAL SOLAR ENERGY PROGRAM

I. Mission Supporting Goals and Objectives: The International Solar Energy Program strives to increase sales and exports of proven renewable energy technologies. By addressing market barriers, the programs "pull" rather than "push" the technologies into the marketplace, thereby bringing economic growth, U.S. jobs, a cleaner environment, and a lower future price for the technologies. The International Solar Energy Program achieves its mission by developing fair and competitive markets for U.S. companies, by utilizing public/private partnerships, and by establishing mechanisms to increase commercial financing resources for major foreign purchases of U.S. technologies.

The International Solar Energy Program was established in response to legislative mandates to help ensure rapid and efficient commercialization of renewable energy technologies, in order to stimulate near-term economic growth and lay the groundwork for long-term growth. It addresses specific problems that slow the acceptance of new and existing technologies and speeds the deployment of technologies by targeting clearly defined markets or distinct market barriers.

The International Solar Energy Program comprises three elements. The Committee on Renewable Energy Commerce and Trade (CORECT) is an interagency group that collaborates with the renewable energy industry to coordinate Federal export activities, support cost-shared trade and economic development projects, and counter intense international competition. The Americas 21st Century Program (A21), developed in accordance with CORECT's strategic plan, assists Latin American and Caribbean (LAC) countries in the deployment of renewable energy technologies through cost-shared joint ventures with the LAC public and private sectors. In FY 1998, A21 will duplicate these activities in the Asia/Pacific region. The U.S. Initiative on Joint Implementation (USIJI) promotes public/private cooperation on projects that reduce greenhouse gas emissions.

A. Estimates of Benefits

The International Solar Energy Program will yield benefits in terms of the environment and energy savings in the countries purchasing the technologies, while increasing U.S. exports, jobs, and Federal tax revenues. By 2000, the Solar International program will stimulate $10-20 in exports for every dollar spent.

B. Performance Measures (highlights)

The following performance measures will be used by the International Solar Energy Program to monitor its progress toward meeting its commitments and goals:

I. Mission Supporting Goals and Objectives (Cont'd):

1996 Performance Measures

- Expanded international strategy into the Asia/Pacific region and approved 10 projects for inclusion in the initiative on Joint Implementation program that could represent private investment of up to $200 million.

1997 Performance Measures

- Coordinate export assistance among Federal agencies for renewable energy technologies, stimulate market development, and avoid wasteful duplication.

- Support voluntary public/private partnerships that use U.S. renewable energy technologies to reduce greenhouse gas emissions.

1998 Performance Measures

- Increase activities in Asian and Pacific markets (China, Indonesia and the Philippines) and continue to build on preliminary work in Africa.

- Increase number of projects receiving assistance that reduce greenhouse gas emissions.

1999-2002 Performance Measures

- Generate significant exports of renewable energy technologies and Federal tax revenues through information dissemination, technical assistance, participation in international organizations and activities aimed at identifying opportunities for renewable energy technologies in other countries.

SOLAR AND RENEWABLE RESOURCE TECHNOLOGIES

INTERNATIONAL SOLAR ENERGY PROGRAM (Cont'd)

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
International Solar Energy Program	$ 3,881	$ 750	$ 7,000	$ 6,250	833%
Total, International Solar Energy Program	**$ 3,881**	**$ 750**	**$ 7,000**	**$ 6,250**	**833%**

III. Performance Summary - Accomplishments:

International Solar Energy Program	FY 1996	FY 1997	FY 1998
CORECT: 1996 - Developed expanded international strategy to include the Asia/Pacific region; monitored existing activities in Chile, Argentina and Brazil; finalized implementation of previously planned activities. 1997 - Continue activity based on available prior year funds. 1998 - Continue to coordinate Federal export assistance to the U.S. renewable energy industry.	$1,981	$0	$2,000
Americas' 21st Century: 1996 - No activity. 1997 - No activity. 1998 - Expand into Asia (China, Indonesia and the Philippines) in addition to Latin America.	$0	$0	$2,500
USIJI (Climate Change Action Plan): 1996 - Significantly increased project development in partnership with non-governmental organizations active in joint implementation activities; USIJI Evaluation Panel conducted workshops, refined project monitoring methodologies, and identified 10 Round II projects in cooperation with other Federal agencies.			

SOLAR AND RENEWABLE RESOURCE TECHNOLOGIES

INTERNATIONAL SOLAR ENERGY PROGRAM (Cont'd)

International Solar Energy Program (Cont'd)	FY 1996	FY 1997	FY 1998
USIJI (Climate Change Action Plan) (Cont'd): 1997 - Continue a number of cost-effective projects implemented jointly between U.S. industry and partners in developing countries and countries with economies in transition, and provide technical assistance to U.S. firms and their partners. 1998 - Assist in the development of public/private partnerships in a greater number of countries.	$1,900	$750	$2,500
TOTAL International Solar Energy Program	**$3,881**	**$750**	**$7,000**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

International Solar Energy Program: The increase of $6,250 will provide funds for Americas' 21st Century program to continue programs in Latin America and expand into Asian/Pacific countries; USIJI will be able to develop more cost-shared projects; CORECT will receive funding to coordinate the Federal export strategy for renewables. (+$6,250,000)

SOLAR AND RENEWABLE ENERGY

SOLAR TECHNOLOGY TRANSFER

I. Mission Supporting Goals and Objectives: The Solar Technology Transfer programs strive to increase sales and exports of proven renewable energy technologies. By addressing market barriers, the programs "pull" rather than "push" the technologies into the marketplace, thereby bringing economic growth, jobs, a cleaner environment, and a lower price for the technologies in the future.

The Solar Technology Transfer programs were established in response to legislative mandates to help ensure rapid and efficient commercialization of renewable energy technologies into domestic markets, in order to stimulate near-term economic growth and lay the groundwork for long-term growth. They address specific problems that slow the acceptance of new and existing technologies and speed deployment of technologies by targeting clearly defined markets or distinct market barriers. The mission of the programs is two-fold: work with industry to accelerate the rate at which viable, new renewable energy technologies are pulled into the marketplace, and increase the extent to which energy market decisions are based on a better understanding of the economics, environmental and energy security benefits of these technologies. The Solar Technology Transfer programs achieve their mission by directly educating consumers, and supporting the development of fair and competitive domestic markets for U.S. technologies through the elimination of market barriers.

The Information and Communications program helps consumers, small and medium businesses, State and local governments, and educators by directly responding to their requests for information and technical assistance regarding EERE technologies (Energy Efficiency and Renewable Energy Clearinghouse), and increases public awareness of EERE technologies by producing information for targeted audiences which otherwise would not know the benefits of using these technologies (Technical Information Program).

A. Estimates of Benefits

The Information and Communications Program will increase the public recognition of the benefits of these technologies and accordingly increase the size and capacity of the markets for these technologies, increasing domestic sales and exports of the technologies.

B. Performance Measures (highlights)

The following performance measures will be used by the Solar Technology Transfer programs to monitor their progress toward meeting their commitments and goals:

I. Mission Supporting Goals and Objectives (Cont'd):

1996 Performance Measures

- Selected an additional 8 commercialization ventures projects to receive financial assistance; will leverage private investment of at least $37 million from these projects.

- Respond to requests for information and achieve a 95% satisfaction rate by user surveys and feedback responses.

- Technical Information Program (TIP) increased the awareness of Energy Efficiency and Renewable Energy (EERE) technologies not otherwise reached by EERE programs (e.g., small- and medium-sized businesses, local governments, educators, and general public).

1997 Performance Measures

- Due to severely reduced funding, EREC will respond to at least 60,000 phone, mail, fax, computer bulletin board, and Internet requests and complete five new EREC publications.

- Survey EREC customers to gauge user satisfaction and obtain feedback for making improvements to information, service quality, and timeliness.

1998 Performance Measures

- EREC will respond to at least 95,000 phone, mail, fax, computer bulletin board, and Internet requests and complete an average of one new EREC publication per month, based on anticipated funding.

- EREC will survey customers to gauge user satisfaction and obtain feedback for making improvements to information, service quality, and timeliness.

- Technology Information Program will continue to seek out and reach audiences not served by EERE programs for targeted distribution of EERE technical information products.

I. Mission Supporting Goals and Objectives (Cont'd):

- The Technology Information Program outreach effort will reach approximately 150,000 customers.

1999-2002 Performance Measures

- EREC will maintain a high level of quality service and user satisfaction by obtaining user feedback and will increase requests/accesses to each by continuing our system improvement and outreach efforts.

- Respond to at least 95,000 phone, mail, fax, computer bulletin board and Internet requests per year through EREC. We will complete one new EREC publication per month on average and promote their availability to appropriate media contacts.

- Technology Information Program will continue to increase awareness of EERE technology readiness and successes by developing and distributing information products that address customers needs.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
Information and Communications	$ 1,339	$ 0	$ 1,360	$ 1,360	100%
Commercialization Ventures	2,840	0	0	0	0%
Tribal Grants	6,600	0	0	0	0%
Total, Solar Technology Transfer	**$ 10,779**	**$ 0**	**$ 1,360**	**$ 1,360**	**100%**

III. Performance Summary - Accomplishments:

Information and Communications	**FY 1996**	**FY 1997**	**FY 1998**
1996 - EREC's ongoing effort produced eight new consumer and educational publications, responded to more than 90,000 telephone, mail, fax, computer bulletin board, and Internet e-mail requests (approximately 20,000 more than projected) for EERE information, and achieved a user satisfaction rating of 95+ percent through surveys and user feedback mechanisms. TIP developed and distributed 5,000 copies of an energy tips for small businesses booklet and completed a 30-fact-sheet series on energy issues pertaining to initiatives for cities and counties in implementing EERE technologies; as a result of a targeted outreach plan, distributed a total of 60,000 copies over several years, largely to local governments. In addition, TIP developed video documentation of the construction of facilities for the summer Olympics that incorporates EERE technologies and developed an online photographic library and database of photos pertaining to EERE and related technologies which was incorporated into EE's Internet Web site. 1997 - Using prior year funds, EREC will respond to 60,000 telephone, mail, fax, computer bulletin board, and Internet e-mail requests due to streamlining of operations; will complete five new EREC fact sheets; and will survey users to gauge satisfaction and obtain ideas for improving the service, while maintaining a 95+ percent satisfaction rating. 1998 - EREC will respond to 95,000 telephone, mail, fax, computer bulletin board, and Internet e-mail requests for information, based on anticipated level of funding; will complete one new EREC fact sheet per month; and will maintain a 95+ percent satisfaction rating. TIP will continue to increase awareness of EERE technology readiness and successes by developing and distributing information products that address specific audience needs. Also, TIP will update video documentation of EERE technologies (including 1996 Summer Olympics); develop materials for the educational audiences; expand distribution of the cities and counties fact sheet series and the energy tips for small business booklet; and work with partners with private interest for bulk purchases of the publications.	$1,339	$0	$1,360
TOTAL Information and Communications	**$1,339**	**$0**	**$1,360**

Commercialization Ventures	**FY 1996**	**FY 1997**	**FY 1998**
1996 - Through the financial advisor, the Commercialization Ventures Program provided financial assistance to new energy businesses, and leveraged significant private investment. Began Management Plan for Renewable Energy and Energy Efficiency Technologies pursuant to Section 1202 of EPACT; plan will assess program needs, objectives and priorities; establish milestones and identify program areas where funding has changed since previous plan.(1994) 1997 - No Activity. 1998 - No Activity.	$2,840	$0	$0
TOTAL Commercialization Ventures	**$2,840**	**$0**	**$0**
Tribal Grants			
1996 - Continued ongoing Navajo transmission project administered by the Western Area Power Administration ($6,100). Provided DOE support for Crow co-generation plant ($500); monitored the FY94 and FY95 grants and conducted orderly shutdown of the program using prior year funds. 1997 - No Activity. 1998 - No Activity.	$6,600	$0	$0
TOTAL Tribal Grants	**$6,600**	**$0**	**$0**
TOTAL Solar Technology Transfer	**$10,779**	**$0**	**$1,360**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Information and Communications: The increase of $1,360,000 will address the concerns of consumers, small business, State and local governments, and educators by directly responding to their requests for information and technical assistance regarding EERE technologies (Energy Efficiency and Renewable Clearinghouse), and increase public awareness of EERE technologies by producing information for targeted audiences which otherwise would not know the benefits of using these technologies (Technical Information Program). (+$1,360,000)

Commercialization Ventures: No change. ($0)

Tribal Grants: No change. ($0)

(+$1,360,000)

SOLAR AND RENEWABLE ENERGY

NATIONAL RENEWABLE ENERGY LABORATORY

I. Mission Supporting Goals and Objectives: Facility operations provide for general purpose equipment purchases and for maintaining and upgrading National Renewable Energy Laboratory facilities to assure continuity of research and integrity of effort in the conduct of research and development projects for Solar and Renewable Energy activities.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
Facility Maintenance	$ 500	$ 500	$ 2,800	$ 2,300	460%
Construction	1,500	2,800	2,200	(600)	-21%
Total, National Renewable Energy Laboratory	**$ 2,000**	**$ 3,300**	**$ 5,000**	**$ 1,700**	**52%**

III. Performance Summary - Accomplishments:

Facility Maintenance	FY 1996	FY 1997	FY 1998
1996 - Provide general repair, retrofit, and maintenance of utilities, roadways and communications systems at NREL. Replace outmoded leased telephone PBX switch at the National Wind Technology Center to accommodate growth at user facility. Provide portable manlift for access to overhead HVAC, electrical, piping, fire protection systems, and research apparatus for Field Test Laboratory Building (FTLB) and Biotechnology Research Facility (BTRF). Add servers to provide additional computer capacity for financial and administrative systems. 1997 - NREL INFRASTRUCTURE - This projects provide unplanned general repair, retrofit, and maintenance for utilities, roadways, and communications systems at the National Wind Technology Center and the South Table Mountain sites.			

Facility Maintenance (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
1997 - ASYNCHRONOUS TRANSFER MODE (ATM) SWITCHES - Obtain and install computer switches to replace outmoded, rented equipment. This new capability will provide high speed switched transfer of data and graphics information, currently transferred using local area network (LAN) and wide area network (WAN) bandwidth. 1997 - PROJECT INFORMATION SERVER - Install a high capacity UNIX server that will make project management information such as costing data, funding, procurement status, and work order available on-line and in organized formats for use by program managers. 1997 - ADMINISTRATIVE AND OTHER EQUIPMENT - Replace and update administration copiers and tools such as contour vertical bandsaw that is inadequate and badly worn, unable to handle increase in work load. 1998 - NREL INFRASTRUCTURE - Provide infrastructure renovations/upgrades at NREL South Table Mountain (STM), and National Wind Technology Center (NWTC) sites. The STM work includes minor site modifications, repaving of roads and parking lots, safety fencing, communications, and landscaping. The NWTC work includes electrical system distribution upgrades, and access road paving. Add metering capability to NREL facilities' electrical systems to maximize energy efficiency utilization and internal energy conservation. 1998 - MESA-TOP SUPPORT STRUCTURE - Provide a single-story multi-user facility of 2,000 square feet that includes space for office/data collection, electronics workshop, optics lab, machine shop, conference space, and permanent toilet and sanitation facilities. The building will support three activities: Solar Radiation Research Laboratory (SRRL), the Solar Industrial Mesa Test Area (SIMTA), and the Solar Furnace Test Facility (SSF).	$500	$500	$2,800
TOTAL Facility Maintenance	**$500**	**$500**	**$2,800**

SOLAR AND RENEWABLE ENERGY

NATIONAL RENEWABLE ENERGY LABORATORY (Cont'd)

Construction	FY 1996	FY 1997	FY 1998
1996 - FIELD TEST LABORATORY BUILDING (FTLB) EXPANSION, PHASE I (PROJECT NO. 96-E-100) - This project is the first phase of three to renovate NREL's Field Test Laboratory Building (FTLB) at the South Table Mountain (STM) site. Scope of work includes upgrading the laboratory exhaust system and converting non-laboratory space into laboratories and research support space. 1997 - FIELD TEST LABORATORY BUILDING (FTLB) EXPANSION, PHASE II - This project is the continuation of the previously approved Line Item Construction Project No. 96-E-100, funded in FY 1996 for $1.5M and is Phase II of a three phase project. This phase of the project will renovate and expand the laboratory and support spaces required for ongoing and evolving activities including those done in collaboration with industrial partners. 1998 - FIELD TEST LABORATORY BUILDING (FTLB) EXPANSION, PHASE III - This is the third phase of modifications to the Field Test Laboratory Building. This last phase provides for the design and construction of a 3,00 square foot conversion of existing space into high bay research laboratories and new space for industrial partners and includes exhaust ventilation, mechanical, and electrical utilities. The laboratories would support research related to the conversion of renewable energy resources to higher value fuels and chemicals.	$1,500	$2,800	$2,200
TOTAL Construction	**$1,500**	**$2,800**	**$2,200**
TOTAL National Renewable Energy Laboratory	**$2,000**	**$3,300**	**$5,000**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Facility Maintenance: The net change of $2,300,000 is required to upgrade existing space in order to provide adequate support for the existing facilities and associated research programs. This includes an increase in Capital Equipment required for computer and copier equipment to keep pace with technology changes and to replace older equipment that had become too expensive to repair and maintain. (+$2,300,000)

Construction: Net change of minus (-) $600,000. The $2,200,000 is to fund only Phase III of the continuation of the FY 1996 Line Item Construction Project No. 96-E-100. This will upgrade the existing space in the Field Test Laboratory Building (FTLB) in order to provide state-of-the-art laboratory and support space for research activities. (-$600,000)

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands. Narrative material in whole dollars)

SOLAR AND RENEWABLE ENERGY

PROJECT DATA SHEETS

1.	Title and location of project:	2a.	Project No.39EB96E100
	FTLB Renovation and Expansion National Renewable Energy Laboratory Golden, Colorado	2b.	Construction Funded

- TEC increased from $5,500,000 to $6,500,000 due to the costs associated with phasing the project over four years vs. two years because of funding restrictions in FY 96.

- TPC increased from $5,800,000 to $6,950,000 due to the costs associated with phasing the project over four years vs. two years because of funding restrictions in FY 96.

1.	Title and location of project: FTLB Renovation and Expansion National Renewable Energy Laboratory Golden, Colorado		2a.	Project No.39EB96E100 Construction Funded	
3a.	Date A/E work initiated:	2nd Qtr., FY 1996	5.	Previous Cost Estimate:	
				TEC	$5,500
				TPC	$5,800
3b.	A/E Work (Titles I and II) Duration:	32 Months			
4a.	Date physical construction starts:	1st Qtr., FY 1997	6.	Current cost estimate:	
4.	Date Construction ends:	1st Qtr., FY 2000		TEC	$6,500
				TPC	$6,950

7. Financial schedule of construction project funding:

Fiscal Year	Appropriations	Obligations	Costs
1996	1,500	1,500	130
1997	2,800	2,800	1,570
1998	2,200	2,200	2,800
1999	0	0	2,000
2000	0	0	0

1.	Title and Location of Project: FTLB Renovation and Expansion National Renewable Energy Laboratory Golden, Colorado	2a. 2b.	Project No: 39EB96E100 Construction Funded

8. Project Description, Justification, and Scope:

The Field Test Laboratory Building (FTLB) expansion and renovation is a modification to an existing facility that will be accomplished in three phases. The facility is located on the existing Department of Energy 121.4 hectares (300 acre) site near Golden, Colorado. A new building addition will be added on approximately 0.2 hectares (½ acre) to the west side of the existing FTLB facility. Landscaping will be natural with minimal improved area adjacent to the building entrance.

The first phase of the project is to improve the building infrastructure. This work consists of renovation/upgrade of the laboratory ventilation and electrical power systems and a conversion of high bay space into functional laboratory. The equipment installation will increase the plant's heating capacity by 100% and the cooling capacity by 80% as well as providing 100% safety redundancy in the three laboratory ventilation systems. 585 square meters (6,300 sf) of high bay area will be converted into two levels for use as fully functional wet laboratory space and support space. The increase in capacity is required to support research and support functions currently performed in expensive leased space.

The second phase of the project is the design and construction of a two story building addition and some building infrastructure consisting of a mezzanine. The addition will consist of support space of approximately 700 square meters (7,500 sf). The building addition will be constructed as a B-2 occupancy in accordance with the Uniform Building Code. The expansion will be connected to the existing FTLB to utilize common utilities and allow for easy access between new and existing laboratories and support spaces. 745 square meters (8,000 sf) of high bay area will be converted into two levels for use as fully functional dry laboratory space and support space. About 745 square meters (8,000 sf) of support space will be available for high bay space and dry laboratories. The increase in capacity is required to support research and support functions currently performed in expensive leased space.

The third phase is the conversion of 410 square meters (4,400 sf) of support space for use as fully functional wet laboratory space and the design, construction, and build-out of the 745 square meters (8,000 sf) of second level floor space provided in phase II into fully function dry laboratory space and support space. This build-out space will be provided with laboratory exhaust ventilation, as well as mechanical and electrical utilities to support the research activities related to conversion of renewable energy resources to higher value fuels and chemicals. This laboratory space will be used to replace expensive leased spaces.

All phases of the project will be fully equipped with automatic fire sprinklers and alarmed for both fire and security. Ventilation systems appropriate for the types of research to be conducted will be provided.

Work performed in FY1996 includes Title I and Title II design, project management, and the initiation of physical construction.

1.	Title and Location of Project:	2a.	Project No: 39EB96E100
	FTLB Renovation and Expansion National Renewable Energy Laboratory Golden, Colorado	2b.	Construction Funded

8. Project Description, Justificaiton,and Scope (continued):

The renovation of laboratory space and addition of support space will enable NREL to maximize the use of the FTLB for general renewables research and development. Completion of this project will reduce operating costs and eliminate the need for third-party participants. This facility will be designed to house process development unit (PDU) size experiments. As these technologies move from the bench scale, it is necessary to develop the overall process concept at the PDU level to verify the economic assessments to attract industry support. This project will provide laboratory space and test facilities for conducting internationally recognized research by NREL researchers, as well as through Cooperative Research and Development Agreements (CRADA) with industry. A $6.5 million total CRADA with Allied Signal is currently in place. This is the first of a series of processes to recover chemical value from mixtures of wastes that NREL is addressing.

In order for industrial partners to be able to work directly with NREL in Cooperative Research and Development Agreements, construction of the new laboratory space is needed. This also will allow NREL to eliminate any need for third party participation and will result in more cost effective research and development for the industries.

Space allocation for the renovation and expansion will include 1,490 square meters (16,000 sf) for high bay laboratories, wet laboratories, dry laboratories, and experimental staging area, and 650 square meters (7,000 sf) of support space. This space includes new and renovated space to support activities of the Biofuels, Biomass power and Industrial Technologies Programs (waste conversion and industrial processes).

The research requirements for thermal conversion technology require high bay research facilities equipped with industrial exhaust ventilation in order to safely conduct experiments on conversion of renewable resources to fuels. Currently, this type of research has been conducted in only one laboratory at the National Renewable Energy Laboratory (NREL) due to the limited high bay space available in current facilities. This project will allow the more efficient use of available high bay space by converting an area formerly used for administrative purposes to high bay laboratory space. The new space will provide the necessary facilities to attract and support cooperative research efforts with industrial partners.

The ventilation upgrades provided by this project are required to provide heating and cooling to the new and converted laboratory and support spaces. This work will also provide for ventilation redundancy required for safe operation of laboratory equipment.

1.	Title and Location of Project: FTLB Renovation and Expansion National Renewable Energy Laboratory Golden, Colorado	2a. 2b.	Project No: 39EB96E100 Construction Funded

9. Details of Cost Estimate:	Unit Cost	Item Cost	Total Cost
a. Design and Management Costs		$ 800	$ 800
1. Engineering design and inspection at approximately 12% of construction costs (item c)		600	
(a) Title I & Title II Design	$ 318		
(b) Title IIIA & Title IIIB	242		
(c) Inspection & Testing Laboratory Services	40		
2. Construction Management Costs		0	
3. Project Management at approximately 4% of construction costs (item c)		200	
b. Land and land rights			0
c. Construction Costs*			4,997
1. Improvements to land**		35	
2. Buildings - approx. 2,138 gsm @ $2,227/gsm (23,000 gsf @ $207 gsf)***		4,761	
3. Other structures		0	
4. Utilities		0	
5. Special Facilities****		201	
d. Standard Equipment			0
e. Major computer items			0
f. Removal cost less salvage			0
g. Design and project liaison, testing, checkout and acceptance			0
Subtotal			5,797
h. Contingencies at approximately 14% of item c			703
I. Total line item cost			6,500
j. Non-Federal contribution			0
k. Net Federal total estimated cost (TEC)			$ 6,500

1.	Title and Location of Project: FTLB Renovation and Expansion National Renewable Energy Laboratory Golden, Colorado	2a. 2b.	Project No: 39EB96E100 Construction Funded

9. Details of Cost Estimate (continued):

* Based on preliminary cost estimate escalated to the midpoint of construction
** Includes costs for modifying the roadway
*** Average per gsm/gsf costs; project encompasses both renovation of existing space and addition of new space
**** Includes laboratory casework

10. Method of Performance

Design and inspection services will be accomplished by fixed price contract(s) with an Architect Engineering firm with additional effort by operating contractor and government employees. Construction and procurement will be by fixed price contract(s) awarded on the basis of competitive bids.

1.	Title and Location of Project:	2a.	Project No: 39EB96E100
	FTLB Renovation and Expansion National Renewable Energy Laboratory Golden, Colorado	2b.	Construction Funded

11. Schedule of Project Funding and Other Related Funding Requirements:

	Prior Years	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
a. Total project costs							
1. Total facility costs							
(a) Line Item (Section 10)	$ 0	$130	$1,570	$2,800	$2,000	$ 0	$6,500
(b) Oper. Exp. funded equipment	0	0	0	0	0	0	0
(c) Inventories	0	130	1,570	2,800	2,000	0	6,500
Total facility cost							
2. Other project costs							
(a) R&D necessary to complete construction project	0	0	0	0	0	0	0
(b) Conceptual design costs	280	20	0	0	0	0	300
(c) Decontamination and Decommissioning (D&D)	0	0	0	0	0	0	0
(d) NEPA Documentation Costs	0	0	0	0	0	0	0
(e) Other related-project costs	0	0	0	0	0	0	
Total other project costs	0	0	0	50	50	50	150
Total project cost	280	150	1,570	2,850	2,050	50	6,950
(f) Non-Federal contribution	0	0	0	0	0	0	0
(g) Total project cost (TPC)	$280	$150	$1,570	$2,850	$2,050	$ 50	$6,950

b. Related annual funding (estimated life of project: 40 years)

1. Facility operating costs (FY 1994 $)	56
2. Facility maintenance and repair costs	37
3. Programmatic operating expenses directly related to the facility	0
4. Capital equipment not related to construction but related to the programmatic effort in the facility	200
5. GPP or other construction related to the programmatic effort in the facility	0

6. Utility costs	62
7. Other costs	0
Total related annual funding	355

13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements:

a. Total project funding

1. Total facility costs
   (a) Line Item: No narrative required.
   (b) Operating expense-funded equipment: None.
   (c) Inventories: None.

2. Other project costs
   (a) R&D necessary to complete construction: No other project funding required.
   (b) Conceptual design: No narrative required.
   (c) Decontamination and decommissioning (D&D): None
   (d) NEPA documentation costs: None.
   (e) Other project related costs: None.
   (f) Non-Federal Contributions: None.

b. Related annual funding

1. Facility operating costs - Included are the salaries and expenses for the NREL Facilities organization and the cost of various subcontracted maintenance and operations activities, in addition to custodial services.
2. Facility maintenance and repair costs - Include estimated maintenance and repair costs.
3. Programmatic operating expenses directly related to the facility - None.
4. Capital equipment not related to construction but related to the programmatic effort in the facility - Includes pyrolysis processing equipment.
5. GPP or other construction related to the programmatic effort in the facility - None.
6. Utility costs - Includes estimated annual utilities costs.
7. Other costs - None.

SOLAR AND RENEWABLE ENERGY

HYDROGEN RESEARCH

I. Mission Supporting Goals and Objectives: The mission of the Hydrogen Research program is to encourage and support the development of cost competitive hydrogen technologies and systems that will reduce the environmental impacts of energy use and enable renewable energy resource penetration into the U.S. energy mix. Hydrogen, produced using renewable energy power systems, including those generated by gasification of biomass, can be stored and transported to U.S. energy end-use markets (utility, transportation, industrial) and converted directly to electricity in a fuel cell or into thermal energy via combustion. To achieve its mission, the hydrogen program has four strategies: (1) expand the use of hydrogen in the near-term by working with industry including hydrogen producers to improve efficiency, lower the emissions, and lower the cost of technologies that produce hydrogen from natural gas for distributed filling stations and to introduce renewable-based options; (2) work with fuel cell manufacturers to develop hydrogen-based electricity storage and generation systems that will enhance the introduction and penetration of distributed, renewable-based utility systems; (3) coordinate with the Department of Defense and DOE's Office of Transportation Technologies to demonstrate safe and cost-effective fueling systems for hydrogen vehicles in urban non-attainment areas; and (4) work with the National Laboratories to lower the cost of technologies that produce hydrogen directly from sunlight and water.

The FY 1998 request continues to implement the program outlined in the Department's Hydrogen Multiyear Plan and recommended by the Hydrogen Technical Advisory Panel. The efforts are directed towards development of critical technologies needed for the introduction of hydrogen into the energy infrastructure. In response to the Hydrogen Future Act of 1996 and the Energy Policy Act of 1992 (EPAct), processes and systems using renewable energy sources to produce hydrogen are one of the highest priorities for development, testing, and evaluation. This program utilizes the core competency of the national laboratories, universities, and industry to develop and demonstrate the processes and technologies needed to produce, store, transport, and utilize hydrogen in various applications. In FY 1998, efforts will proceed with cost-shared joint ventures with industry on near-term hydrogen options, support of hydrogen fuel cell vehicle program, biomass gasification for hydrogen production, and completion of the Palm Desert new electric vehicle program. In addition, activities will focus on increasing the efficiency of photolytic and thermal production methods, reducing the cost of hydrogen storage, increasing the energy density of storage, and demonstrating the environmental benefits of using hydrogen.

I. Mission Supporting Goals and Objectives (Cont'd):

A. Estimates of Benefits:

The estimated benefits are based on a contribution of hydrogen fuel cells to the nation's future electricity generation mix. Hydrogen fuel cells are expected to account for 36 GW, a 4.2% share of the projected U.S. total by the year 2020. Between 2016-2020, models project installation of an additional 21 GW of fuel cells, 27% of all new electric capacity.

These are cumulative benefits assuming a baseline of zero in 1996.

	2000	2010	2020
Annual Primary Energy Displaced	0.00 Q	0.01 Q	1.16 Q
Annual Displaced Electricity Value ($0.07/kWh)	$7 M	$73 M	$8,100 M
Carbon Equivalent Emissions Reductions	0.02 MMT	0.15 MMT	17 MMT

B. Goals

- 2000 - Non-energy cost of electricity from baseload renewable options will be reduced to 5 cents/kWh.
- 2002 - Non-energy cost of electricity from hydrogen-based storage systems will be lowered to 5 cents/kWh.
- 2002 - Plant cost of renewable hydrogen produced directly from sunlight and water will be reduced to 9 $/MMBtu.
- 2002 - The cost of hydrogen delivered to a vehicle at pressure will be reduced to 12-15 $ /MMBtu.
- 2005 - Hydrogen use increases from 0.3Q/yr (as a chemical feedstock to produce reformulated gasoline), to 0.6Q/yr (as a transportation fuel and chemical feedstock), the equivalent of 54 million barrels of oil increase.
- 2010 - Deployment of new production technologies reduces emissions by: 61,000 tons per year NOx, 1,000,000 tons per year CO, and 46 million tons per year CO2.

I. Mission Supporting Goals and Objectives (Cont'd):

- 2010 - Biomass and municipal solid waste gasification contribute the equivalent of 0.2Q/yr production capacity of hydrogen.
- 2020 - Hydrogen based systems will displace fossil fuels in utility, building, and vehicle applications leading to 1 Quad use.
- 2025 - Renewable energy source hydrogen production contribute the equivalent of 10Q/yr in the primary energy market.

C. Performance Measures

FY 1996 Performance Measures

- Developed sorbent enhanced membrane for carbon dioxide which meets the following: > 0.3 mmol/gram CO_2 at 400-500° C in the presence of excess skan, stable after more than 60 cycles; and fast kinetics.
- Demonstrated 23 percent conversion of bromine to hydrobromic acid at 1160° C, 60 percent of theoretical.
- Demonstrated a solar-to-hydrogen conversion efficiencies as high as 7.8% under natural sunlight with no degradation.

FY 1997 Performance Measures

- Operate experimental engineering evaluation platform which integrates PEM fuel cells with metal hydride storage and delivery system. Collect data on hydride storage cost and performance, safety, refueling, efficiency, maintenance complexity, and sensors.
- Construct and demonstrate a process development unit (PDU) size bioreactor to test the feasibility of producing hydrogen from oxygen tolerant algal mutants on a continuous basis.
- Design a process development unit to demonstrate sorbent enhanced steam methane reforming scaled to 0.1 MM SCFD of hydrogen.
- Complete the design of a pure hydrogen-fueled phosphoric acid fuel cell for stationary power generation.

I. Mission Supporting Goals and Objectives (Cont'd):

- Complete 9 case studies for near-term hydrogen opportunities, biomass gasification, and hydrogen filling stations.

FY 1998 Performance Measures

- Complete phase one of cost-shared hydrogen option.

FY 1999 - 2002 Performance Measures

- Operate new hydrogen-fueled electric vehicle in city driving.
- Demonstrate certifiable hydrogen storage for vehicles.
- Demonstrate integration of biologically catalyzed water gas shift reactor to biomass pyrolysis for hydrogen production in a PDU scale.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
Hydrogen Research	$ 14,331	$ 15,000	$ 15,000	$ 0	0%
Total, Hydrogen Research	**$ 14,331**	**$ 15,000**	**$ 15,000**	**$ 0**	**0%**

III. Performance Summary - Accomplishments:

Hydrogen Research	FY 1996	FY 1997	FY 1998
Core Research & Development: Activities will focus on increasing the efficiency of photolytic and thermal processes to produce hydrogen, increase the performance of hydrogen storage technologies, and demonstrate improvements in emissions and the total system efficiencies. **I. Production**: Efforts are focused on reforming and purification, biomass gasification and photolytic processes to produce hydrogen at 6-9 $/MMBtu. **Distributed Reforming/Purification**: 1996 - Demonstrated stable catalyst for sorbent enhanced reforming (SER) for CO_2 free natural gas reforming. Demonstrated scaleup from 1kW to 10kW HBr reactor. 1997 - Demonstrate proof-of-concept reversible HBr fuel cell for production and utilization. Demonstrate SER cyclic efficiency in sub-scale testing. Award contract for ion transport membrane for more efficient production of hydrogen for carbonaceous feedstocks. 1998 - Demonstrate SER process development unit for optimization, scale-up, and integration.	$1,748	$1,306	$2,100
Biomass Gasification: 1996 - Demonstrated new catalysts to reform gasified biomass. 1997 - Complete characterization of gasification products from Texaco gasifier. 1998 - Complete scale-up for hydrogen production efficiency and obtain process characterization data. Award contract for design and construction of a cost-shared biomass to hydrogen gasifier system.	$1,216	$1,104	$1,357

SOLAR AND RENEWABLE ENERGY

HYDROGEN RESEARCH (Cont'd)

Hydrogen Research (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
Photolytic Processes: 1996 - Developed stable SiC films for direct solar water splitting and designed test cells for evaluation. Evaluated a new single photon algae catalyzed process for solar water splitting. 1997 - Improve SiC film performance through modification of alloy coatings with resulting increased hydrogen production and lower overall cost. 1998 - Develop amorphous silicon and hybrid cells for high efficiency, direct solar hydrogen production demonstrations. Complete development of long-life algae system for higher efficiency single photon hydrogen production.	$1,660	$2,003	$1,780
II. Storage: Efforts are focused on developing storage materials and systems that exceed 5.5% by weight hydrogen for utility and transportation applications. 1996 - Assembled and demonstrated proof-of-concept metal hydride storage system with an interim goal exceeding 3% by weight using an advanced alloying process. 1997 - Assemble and demonstrate proof-of-concept light weight magnesium, aluminum, copper alloy exceeding 5% by weight and transfer technology to industry. 1998 - Select optimum carbon based adsorbent material, fabricate and characterize prototype storage system to determine practical feasibility.	$1,953	$2,134	$1,848

SOLAR AND RENEWABLE ENERGY

HYDROGEN RESEARCH (Cont'd)

Hydrogen Research (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
III. Utilization: Efforts are focused on developing and demonstrating end-use technologies that are safe, and have near-zero or zero emissions with an overall efficiency greater than 45%. 1996 - Developed photochromic hydrogen sensor. Developed and tested an advanced hydrogen fueled Internal Combustion Engine (ICE). 1997 - Complete the design of a pure hydrogen fueled phosphoric acid fuel cell for stationary power generation. 1998 - Assemble 5 kW prototype proton exchange membrane fuel cell using advanced manufacturing processes.	$1,642	$1,280	$890
TOTAL Core Research & Development	$8,219	$7,827	$7,975
Technology Validation: Efforts are focused on developing cost-shared joint ventures with industry on hydrogen refueling stations, vehicle storage, reversible fuel cells and high temperature, advanced fuel cells. 1996 - Complete the release of a solicitation for cost-shared ventures with industry on biomass gasification and hydrogen refueling. 1997 - Award contracts for cost-shared development of hydrogen storage systems and hydrogen production infrastructure to support Proton Exchange Membrane (PEM) fuel cell distributed utility and vehicle activities. 1998 - Initiate the development of hydrogen refueling stations. Complete development plans of cost-shared ventures with industry on hydrogen options from solicitation and enter into design and construction phase for three ventures.	**$2,409**	**$3,756**	**$4,351**

SOLAR AND RENEWABLE ENERGY

HYDROGEN RESEARCH (Cont'd)

Hydrogen Research (Cont'd)	FY 1996	FY 1997	FY 1998
Analysis and Outreach: Conduct portfolio analyses to verify hydrogen technologies can meet cost and performance goals, assist the private sector in determining steps to create hydrogen energy markets. Increase awareness of the benefits of hydrogen and encourage participation of stakeholder groups. 1996 - Developed industry/government collaboration to accelerate commercialization of technologies. Demonstrated educational compact disk (CD) on hydrogen technologies for middle school. 1997 - Demonstrate advanced computational model to predict hydrogen production from gasification and pyrolysis. Develop and implement curriculum for Los Angeles schools, including upgrading of the CD to cover all renewable-energy-based hydrogen production technologies. 1998 - Expand code and standards activities to integrate U.S. and foreign activities, develop comprehensive requirements. Complete 5 year implementation plan. Complete hydrogen infrastructure report for a prototype city.	$3,703	$3,417	$2,674
TOTAL Hydrogen Research	**$14,331**	**$15,000**	**$15,000**

***FUNDING CHANGES FROM FY 1997 TO FY 1998*:**

Hydrogen Research: There is no change in funding from FY 1997 to FY 1998. ($0)

OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

HYDROPOWER DEVELOPMENT

I. Mission Supporting Goals and Objectives: The mission of the U.S. Department of Energy's Hydropower Program is to improve the technical, societal, and environmental benefits of hydropower by conducting and coordinating research and development with industry and other Federal agencies. The primary goal is to develop advanced technology which will balance environmental, engineering, and cost considerations. Improved environmental performance will help meet regulatory conditions in licensing and relicensing and help preserve hydropower's contribution to U.S. energy production. The FY 1997 Energy and Water Development Appropriations Report Language for Solar and Renewable Programs designated funding for Renewable Indian Energy projects under the Hydropower Program.

Resource Assessment

The program conducts standardized hydropower resource assessments for each state. These assessments utilize environmental attributes of each hydropower site to calculate a relative development suitability factor for a project.

- Twenty-four states have been completed. Assessments for the remaining states to be completed by the end of FY 1998.

Advanced Hydropower Turbine System

Objectives are to design, develop, build, and test environmentally friendly advanced systems. This program is planned to be conducted in three phases if sufficient funding is provided, and will be cost shared with industry:

- Phase I - Develop conceptual engineering designs. Two contracts for Phase I designs were awarded in October 1995. The designs are scheduled for completion December 1996, and April 1997, respectively.

- Phase II - Develop fully engineered designs.

- Phase III - Build and test full-scale prototypes of the most promising models in actual operating hydropower plants.

At the proposed funding levels the Hydropower Program is expected to yield the following performance goals and benefits:

OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

HYDROPOWER DEVELOPMENT

I. Mission Supporting Goals and Objectives (Cont'd):

A. Estimates of Benefits

The primary benefit will be the development of biological criteria for the hydropower industry, both as a basis for industry-conducted advanced turbine development and for regulatory compliance. More realistic estimates of practical hydropower resources for the Nation will result from application of uniform environmental and institutional criteria.

B. Performance Goals

Performance Measures over five years follow:

- Completion of updated hydropower resource assessments for all fifty states.
- Completion of three biological studies of component stresses on fish resulting from fish entrainment (initiated in FY 1997).

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
Hydropower Development	$ 3,483	$ 1,000	$ 1,000	$ 0	0%
Total, Hydropower Development	**$3,483***	**$ 1,000**	**$ 1,000**	**$ 0**	**0%**

* Includes $2,000 for Haida Hydroelectric program.

OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

HYDROPOWER DEVELOPMENT

III. Performance Summary - Accomplishments:

Hydropower Development	FY 1996	FY 1997	FY 1998
Hydropower: 1996 - Initiated development of biological criteria for design of advanced hydropower turbines. Completed hydropower resource assessments for ten additional states. 1997 - Complete four conceptual designs for advanced hydropower turbines. Complete resource assessments for ten additional states. 1998 - Complete resource assessment for final sixteen states. Complete development of biological criteria for shear stresses on fish entrained in hydropower systems.	$1,483	$1,000	$1,000
Haida Alaska Native Village Corporation's Reynolds Creek Hydroelectric Program: 1996 - Negotiations initiated with the Haida Corporation. 1997 - Funds appropriated under Indian Energy Resources. 1998 - No funding requested.	**$2,000**	**$0**	**$0**
TOTAL Hydropower Development	**$3,483**	**$1,000**	**$1,000**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Hydropower Development: No major changes. ($0)

SOLAR AND RENEWABLE RESOURCE TECHNOLOGIES

RENEWABLE INDIAN ENERGY RESOURCES PROGRAM

I. Mission Supporting Goals and Objectives: The FY 1997 Energy and Water Development Appropriations Report language for Solar and Renewable Energy Programs designated funding for renewable Indian energy projects.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
Renewable Indian Energy Resources Program	$ 0	$ 4,000	$ 0	$ -4,000	-100%
Total, Renewable Indian Energy Resources	**$ 0**	**$ 4,000**	**$ 0**	**$ -4,000**	**-100%**

III. Performance Summary - Accomplishments:

Renewable Indian Energy Resources Program	FY 1996	FY 1997	FY 1998
Haida Alaska Native Village Corporation's Reynolds Creek Hydroelectric Program: 1996 - Funds were reallocated from within the ESR&D appropriation account and were subsequently managed by the Hydropower R&D program. 1997 - Cooperative agreement negotiated and in place. 1998 - No funding requested.	$0	$1,000	$0
Eyak Native Corporation's Power Creek Hydroelectric Project: 1996 - No funding appropriated. 1997 - Cooperative agreement negotiated and in place. 1998 - No funding requested.	$0	$2,000	$0

SOLAR AND RENEWABLE RESOURCE TECHNOLOGIES

RENEWABLE INDIAN ENERGY RESOURCES PROGRAM (Cont'd)

Klawock Thorne Bay-Kasaan Electrical Intertie: 1996 - No funding appropriated. 1997 - Cooperative agreement negotiated and in place. 1998 - No funding requested.	$0	$1,000	$0
TOTAL Renewable Indian Energy Resources Program	**$0**	**$4,000**	**$0**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Renewable Indian Energy Resources Program: No funding requested. (-$4,000)

SOLAR AND RENEWABLE ENERGY

ELECTRIC ENERGY SYSTEMS AND STORAGE

I. Mission Supporting Goals and Objectives: The primary mission of the Electric Energy Systems and Storage Program is to develop, in collaboration with industry, advanced power delivery technologies that will: 1) increase the efficiency, flexibility and capacity of the Nation's electric power systems; 2) increase utilization of renewable energy sources; 3) fulfill requirements of customers and utilities in the new competitive environment. These technologies will enable high quality, reliably-delivered power.

High Temperature Superconductivity and Energy Storage R&D programs will create energy efficient technologies that will enhance renewable penetration, enhance power quality and reliability, increase system capacity, enhance asset utilization and increase U.S. industrial competitiveness. Electricity-related institutional and environmental issues that affect the implementation of efficient and cost-effective power delivery are addressed by the Electric and Magnetic Fields (EMF) and Climate Challenge Programs.

HIGH TEMPERATURE SUPERCONDUCTIVITY: DESCRIPTION, BENEFITS, AND PERFORMANCE MEASURES:

The Department leads the national effort to capture the energy saving potential of superconductivity - the ability of certain materials to be high capacity carriers of electricity without having the resistance losses inherent in normal conductors, such as copper. The program has mobilized the resources of U.S. industry, national laboratories and universities to accomplish two major technological goals: solving the difficult problem of manufacturing electrical wires from the family of brittle ceramic superconducting materials discovered in 1986 while, in parallel, creating designs of superefficient electrical systems such as motors, transmission cables, generators, transformers and current limiters that use these wires.

Superconductivity has the potential to bring about an energy revolution as profound as the impact fiber optics has had on communication. The information superhighway has largely been constructed by replacing copper wires with much higher capacity fiber optic wires. Superconducting wires, with 100 times the carrying capability of copper wires, will result in transmission cables with 5 times the capacity. Also, motors, generators, and transformers can be built that are half the size and weight of conventional systems. Furthermore, these advanced systems will have only half the energy losses of the conventional alternatives.

The program supports aggressive industry-led projects to design advanced electrical systems as part of the Superconductivity Partnership Initiative and to exploit recent research breakthroughs under the Second Generation Wire Initiative. The very successful Superconductivity Partnership Initiative features vertically integrated teams (typically including an electric utility, a system manufacturer and a superconducting wire supplier as well as one or more national labs) who design and build motors, power cables and current limiters. Begun in FY 1996, the Second Generation Wire Initiative is exploiting research breakthroughs at Los Alamos and Oak Ridge National labs that promise unprecedented current-carrying capacity in high-temperature superconducting wires. These breakthroughs, which made headlines worldwide, will allow long wire lengths to behave as a single crystal, thus eliminating present barriers to current flow that may limit use of wires now being manufactured.

I. Mission Supporting Goals and Objectives (Cont'd)

The underlying knowledge base needed for the success of the above industry-led projects is provided by the Strategic Research part of the program. The Second Generation Wire Initiative evolved from five years of strategic research that achieved world record performance breakthroughs in short wire samples. Strategic research will continue on wire processing as well as exploratory research on transformers, magnetic separation and other systems. In addition, research and analysis relating to restructuring in the electric utility industry will be conducted on issues associated with integration of superconducting systems into an increasingly competitive industry framework.

Superconductivity - Utility Sector - Key Activities

Superconductivity Partnership Initiative (SPI) The SPI is a focused team effort by the DOE and industry to design early prototypes of utility technologies such as motors, generators, and power cables. Phase 1 (small scale design) efforts were successfully completed in FY 1996 and set world records on motors, generators, power cables and current limiters. Phase 2 (full scale design) projects were selected in FY 1997 for motors, power cables, and current limiters. A second SPI solicitation in FY 1998 will yield projects for design of other critical utility components, such as transformers.

Second Generation Wire Initiative Research breakthroughs were made at Los Alamos and Oak Ridge National laboratories in FY 1995 and FY 1996 that promise to dramatically improve performance and cost of high temperature superconducting wires. The "first generation" wires currently supporting SPI design activities may not meet future commercialization requirements. These requirements can be met through DOE and industry aggressively pursuing the lab breakthroughs in this initiative. Continued parallel improvement in existing wire performance is needed and is supported under the SPI.

Strategic Research This cutting edge research at national labs, private companies, and universities has led to much of the success achieved so far. The breakthroughs now being exploited in the Second Generation Wire Initiative were achieved in this activity which typically includes 20 cooperative research and development agreements with private companies. Alternative wire processing research is done as well as fundamental research on transformers, magnetic separation equipment, and other end-use systems.

A. Estimates of Benefits

At the proposed funding level, the Superconductivity program is expected to yield the following quantifiable benefits; these are cumulative benefits assuming a baseline of zero in 1996:

I. Mission Supporting Goals and Objectives (Cont'd)

Superconductivity	2000	2010	2020
Direct Oil Displaced (million barrels per year)	0	0.05	0.91
Annual Displaced Energy Displaced (Q)	0	0.0157	0.1963
Annual Displaced Electricity Value ($M)	0	239	1025
Carbon Equivalent Emissions Reductions (MMT) per annum	0	0.0482	0.6885

B. Performance Measures

Success is measured by improving the ability to carry large currents and lowering the cost of superconducting electric wire, creating designs for powerful, high efficiency energy systems using these wires, performing world-class research, and keeping the U.S. in a position of leadership in advancing this new technology.

FY 1996 Performance Measures

- Achieve world class research results
- Surpass world performance record for superconducting motors
- Surpass world performance record for superconducting power cables

FY 1997 Performance Measures

- The status and prospects of the U. S. superconductivity research program are evaluated against those of major competitors in Japan and Germany.
- Expand industry-led program to exploit processing breakthroughs at Los Alamos and Oak Ridge that will lead to a second generation of HTS wire being commercially available in 2002 with significantly improved performance and lower cost.
- Design HTS motors that set new world performance records.

I. Mission Supporting Goals and Objectives (Cont'd)

FY 1998 Performance Measures

- Meet current limiter requirements and finish current limiter project.
- Select competition for new Superconductivity Partnership Initiative project teams in competitive action.
- Reach initial scale-up requirements of Los Alamos/Oak Ridge wire processing breakthroughs.

FY 1999-2002 Performance Measures

- Reach HTS wire cost goal of $0.01 per ampere-meter (now over $1.00).
- Reach HTS wire performance goal of 100 times the carry capacity of copper wires.
- Meet final goals of Superconductivity Partnership Initiative power cable project.
- Meet final goals of Superconductivity Partnership Initiative motor project.
- U. S. industry is positioned to begin commercialization of a new generation of advanced energy products.

ENERGY STORAGE: DESCRIPTION, BENEFITS, AND PERFORMANCE MEASURES

The mission of the Energy Storage Systems (ESS) Research and Development Program is, by leveraging resources with the electric utility and manufacturing industries, to ensure that energy storage systems will be technically attractive and cost-effective utility resource options by the end of this decade. Successful implementation of the ESS Program will increase the energy security of the Nation; reduce the environmental impact of electricity generation, transmission, and use; and increase the value to utilities of diverse generation such as distributed and renewable resources.

Utilities are now planning how to use technologies such as energy storage and renewable generation in a deregulated, competitive, and environmentally conscious business climate. Energy storage is an option that, when fully developed, can help utilities address these issues by improving cost-effectiveness, reliability, power quality, efficiency, and utilization of renewables while reducing the environmental impact of

I. Mission Supporting Goals and Objectives (Cont'd)

electricity generation, transmission, and distribution. Energy storage system provides utilities with flexible, virtually instantaneous (one-quarter cycle) power and energy for over 10 applications using modular, transportable systems; prototype battery energy storage installations are being field tested. Given declining utility investment in R&D, federal investment in storage R&D will impact reliability and cost in wide areas of the country and for large industrial sectors, and can accelerate adoption of sustainable energy technologies.

A. Estimates of Benefits

At the proposed funding level, the Energy Storage Systems R&D program is expected to yield the following quantifiable benefits; these are cumulative benefits assuming a baseline of zero in 1996:

	2000	2010	2020
Annual Primary Energy Displaced (Quads)	0.0015	0.016	0.027
Annual Energy Cost Savings ($M)	4.2	62.4	131
Direct Oil Displaced (Million barrels)	0.07	0.28	0.28
Carbon Equivalent Emissions Reductions (MMT)	0.0242	0.2434	0.405

Additional benefits of Energy Storage Systems R&D will be to achieve the installation of 30 GW of energy storage by the year 2020, with a potential savings to U.S. consumers (residential and industry) of over $57B. In addition to the benefits of energy saved, energy storage also will increase the value of utility power through increased power quality. The deregulation of utilities is bringing about a period of change and uncertainty; deferral of retrofits and upgrades through the increased use of storage may be a preferred strategy until the business climate has stabilized. The primary goal of the Energy Storage Systems program is to provide advance technology to increase reliability and performance and therefore competitiveness (including reducing the environmental impact) of generation, transmission, and distribution in the U.S. electric grid system. Success will help increase U.S. industry competitiveness by improving power quality and reliability.

SOLAR AND RENEWABLE ENERGY

ELECTRIC ENERGY SYSTEMS AND STORAGE (Cont'd)

I. Mission Supporting Goals and Objectives (Cont'd)

B. Performance Measures

FY 1996 Performance Measures

- Developed storage systems which met the current cost goal of $1000 per kW.
- Demonstrated an energy footprint in a battery storage system of 1.5 kWh/square foot.

FY 1997 Performance Measures

- Develop flexible storage systems which meet the cost goal of $900 per kW.
- Increase industry cost-share to 50% in new prototype development projects.

FY 1998 Performance Measures

- Demonstrate transportable power quality systems; power quality problems cost U.S. industry $40B/year.
- Increase the energy available in a battery storage system from 1.5 to 3 kWh/square foot.

FY 1999-2002 Performance Measures

- Increase the amount of new energy storage installed on utility networks by 500 MW.
- Develop flexible storage systems which meet the cost goal of $800 per kW.
- Increase the energy available in a battery storage system from 1.5 to 5 kWh/square foot.
- Increase the AC-to-AC efficiency from 70% to 75% with the use of improved devices and power electronics.

I. Mission Supporting Goals and Objectives (Cont'd)

ELECTRIC AND MAGNETIC FIELDS DESCRIPTION, BENEFITS, AND PERFORMANCE MEASURES:

The Electric and Magnetic Fields R&D program manages a portfolio of coordinated health effects research and exposure measurements that will enable the National Institute of Environmental Health Sciences (NIEHS) to assess the risk to human health from exposures to electric and magnetic fields that are associated with the generation, delivery and use of electricity. It also supports communication efforts to keep the public and other decision makers informed about this issue. This portfolio consists of two coordinated and interdependent subprograms: the EMF Biological Mechanisms Research program for which $4 million is being requested and the five-year EMF Research and Public Information Dissemination program for which $4 million is requested for its fifth and final year. Both programs are focused on providing information for risk assessment. FY 1998 is the final year for the Department's EMF research efforts.

A. Estimates of Benefits

Private sector sources estimate that the public concern about uncertainty over whether exposure to electric and magnetic fields (EMF) causes health effects already costs the Nation more than $1 billion per year. Some studies suggest, but have not proven, that higher magnetic field exposures from proximity to power lines and electrical equipment result in an increase in the incidence of diseases such as leukemia, brain tumor, breast cancer, and Alzheimer's disease. The five-year EMF Research and Public Information Dissemination program and the coordinated EMF Biological Mechanisms Research program will provide the scientific information base for a risk assessment to be performed by The National Institute of Environmental Health Sciences in 1998. This should significantly reduce uncertainty on the issue and enable policy makers and the public to make informed decisions.

B. Performance Measures (highlights)

The following performance measures will be used by the Electric and Magnetic Fields (EMF) R&D program to track its commitments to significantly reduce uncertainty on this potential health issue and enable policy makers and the public to make informed decisions.

FY 1996 Performance Measures

- Documented extensive peer review activities for the EMF program.
- Initiated extensive research to replicate key findings.

I. Mission Supporting Goals and Objectives (Cont'd)

- Received and distributed National Academy of Sciences report on Possible Health Effects of Exposure to Residential Electric and Magnetic Fields.

- Completed booklet on EMF in the Workplace.

FY 1997 Performance Measures

- Disseminate current and credible information on the issue, to all stakeholders and other interested parties.

- Initiate small NIEHS grants to fill research gaps and continue evaluation of cellular and hormonal effects.

FY 1998 Performance Measures

- Complete planned health effects research and exposure assessments leading to a risk assessment by the National Institute of Environmental Health Sciences in 1998.

- Publish and disseminate a risk assessment (by NIEHS) concerning health effects from exposure to electric and magnetic fields.

FY 1999-2002 Performance Measures

- None

CLIMATE CHALLENGE: DESCRIPTION, BENEFITS, AND PERFORMANCE MEASURES

Climate Change Action Plan -- Partnerships for Technology Introduction: The mission of the Climate Challenge program is to offer encouragement to the electric utility industry to voluntarily reduce, avoid, or sequester greenhouse gas emissions using currently available, cost-effective ("no-regrets") means. The voluntary effort on the part of both the electric utility industry and the Department of Energy is in response to the 1992 Framework Convention on Climate Change treaty. It was formally launched in April 1994 through the signing of a Memorandum of Understanding between all the major electric utility trade associations and DOE. Electric utilities voluntarily sign agreements with DOE that commit them to individualized, flexible plans to achieve reductions. In addition to making reductions in their own operations, utilities can contribute to any of nine industry-wide initiatives which the trade associations have developed in support of Climate Challenge.

I. Mission Supporting Goals and Objectives (Cont'd)

DOE, in return, makes information more readily available, reports on the progress of the program, and provides a forum that publicly recognizes the utility participants.

A. Estimates of Benefits

The Climate Challenge program offers numerous benefits to the Nation. These include:

- Demonstrates the value of using voluntary cooperation from industry, rather than traditional command-and-control regulation, to achieve environmental objectives. This program is highly popular with industry as a prudent response to the climate change issue.

- Achieves measurable greenhouse gas reductions. As of August 1996, over 600 utilities (accounting for over 61 percent of U.S. electrical generation and current carbon emissions) had either signed individually or participated in 114 agreements with DOE. DOE estimates that these reported commitments will reduce emissions by over 44 million metric tons of carbon equivalent in the year 2000. This estimate is conservative, as it does not include reductions not yet quantified, such as results from the nine industry-wide initiatives.

- Raises awareness of the many cost-effective methods available to electric utilities to reduce greenhouse gas emissions, so that greenhouse gas mitigation is a factor considered in utility planning and management.

- Spurs the utility industry voluntarily to make investments in new energy-efficient and renewable energy technologies and projects.

- Strengthens the U.S. position in the on-going international climate change negotiations.

B. Performance Measures

FY 1996-2000 Performance Measures

- As a measure of the efficacy of using voluntary means rather than command-and-control regulation, the Climate Challenge program voluntarily tracks the continued acceptance by the utility industry of the use of voluntary, cost-effective, "no regrets" methods to reduce greenhouse gas emissions.

- Climate Challenge program planning estimates hope to sign up over 650 utilities by 1997, and over 750 members by 1999.

- Over 44 MMTCE of greenhouse gas reductions in the year 2000 from the Climate Challenge utilities is pledged.

FY 2000-2002 Performance Measures

- A minimum of 44 MMTCE of greenhouse gas reductions annually is expected post-2000.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
High Temperature Superconductivity R&D	$ 22,280	$ 19,750	$ 32,500	$ 12,750	65%
Energy Storage R&D	1,977	4,000	4,000	0	0%
Electric and Magnetic Fields R&D	9,487	8,000	8,000	0	0%
Climate Challenge	0	0	1,000	1,000	??
Total, Electric Energy Systems and Storage	**$ 33,744**	**$ 31,750**	**$ 45,500**	**$ 13,750**	**43%**

III. Performance Summary - Accomplishments:

High-Temperature Superconductivity R&D	FY 1996	FY 1997	FY 1998
Superconductivity Partnership Initiative: 1996 - Completed Phase I (small scale design) motor, generator, power cable and current limiter projects, setting world records in each. Capacity doubled of "first generation" wires used in these projects. R&D 100 award made for wire manufacturing improvements. 1997 - Awarded Phase II (full scale design) continuations to motor, power cable and current limiter projects. 1998 - Awards made for new Phase I projects. Current limiter commercialization activities using industry funding.	$8,000	$9,500	$14,500

SOLAR AND RENEWABLE ENERGY

ELECTRIC ENERGY SYSTEMS AND STORAGE (Cont'd)

High-Temperature Superconductivity R&D (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
Second Generation Wire Initiative: 1996 - Two industrial consortia join Los Alamos and Oak Ridge in beginning scale-up of research breakthroughs (1 centimeter length) at the labs. 1997 - 1 meter length superconducting wire manufactured using industrial practices. The wire has 20 times the capacity of comparable copper wire with no resistance loss. 1998 - 10 meter length manufactured. Commitment made by industrial partner to build pilot manufacturing plant.	$4,000	$5,000	$8,000
Strategic Research: 1996 - R&D 100 award made for novel imaging system that visually shows, for the first time, how electrical current flows in these superconducting wires. Expert study group completes visit to Japan and Germany to obtain information on their superconductivity research and development programs. 1997 - Design and testing accomplished of a small-scale (1MVA) novel, environmentally benign, more efficient electric utility transformer. Report distributed showing U.S.-based technology has competitive edge but foreign programs devoting larger share of R&D budget in attempt to overtake us. 1998 - Initial coils made with second generation wires. Research results continue to support both the Superconductivity Partnership and Second Generation Wire initiatives.	$10,280	$5,250	$10,000
TOTAL High-Temperature Superconductivity R&D	**$22,280**	**$19,750**	**$32,500**
Energy Storage R&D			
Storage System Integration: Systems integration of cost-effective storage resource options for both utility and consumer. 1996 - Initiated industry participation in development of transportable storage device (TBESS) to address $40 billion/year power quality problem. Evaluated proposals for cost-shared advanced storage system (ABESS) for customer peak shaving and transmission line stability.			

SOLAR AND RENEWABLE ENERGY

ELECTRIC ENERGY SYSTEMS AND STORAGE (Cont'd)

Energy Storage R&D (Cont'd)	FY 1996	FY 1997	FY 1998
Storage System Integration (Cont'd): 1997 - Initiate design of integrated PV/storage system (RGS) that will reliably provide seamless transfer of power. Initiate Secure Bus project to provide quality power to all customers served by utility substations. Initiate ABESS project. 1998 - Formulate new technologies for deregulated systems in response to intensive 1997 evaluation and recommendations (see analysis). Complete testing of TBESS. Prepare for Secure Bus demonstration in 12-kV substation. Continue ABESS and RGS.	$800	$1,850	$2,010
Key Components for Storage Systems: Develop the key components needed for tomorrow's efficient, low-cost, reliable storage systems. 1996 - Developed next generation storage technology and efficient, cost-effective control electronics. 1997 - Initiate evaluation of flywheels and SMES storage technologies. 1998 - Develop critical Secure Bus components (advanced inverters). Continue to develop advanced storage and electronics.	$730	$1,160	$1,400
Analysis and New Program Emphasis: Quantify high impact applications and utility requirements for storage systems. High activity level in 1997 will lead to repositioning of program for restructured electricity marketplace. 1996 - Extended currently-used utility models to analyze effects of storage on grid. Finished work with several utility partners to project costs of storage in their system. Projected storage penetration in utility and PV applications. 1997 - As input for new program emphasis, evaluate the storage needs of deregulated, dispersed utilities. Examine value of storage for renewable energy and hybrid storage applications.			

SOLAR AND RENEWABLE ENERGY

ELECTRIC ENERGY SYSTEMS AND STORAGE (Cont'd)

Energy Storage R&D (Cont'd)	**FY 1996**	**FY 1997**	**FY 1998**
Analysis and New Program Emphasis (Cont'd): 1998 - Examine value of storage in reducing power quality problems and avoiding multi-state power outages.	$447	$990	$590
TOTAL Energy Storage R&D	**$1,977**	**$4,000**	**$4,000**
Electric and Magnetic Fields R&D			
1996 - Continued basic research into biological effects of electric and magnetic fields. Documented extensive peer review activities of the program. Began intensive research to replicate key findings, using advanced EMF exposure systems at four Government laboratories. Received and distributed National Academy of Science report on biological effect of EMF and preliminary evaluation of potential health risks. Obtained matching non-Federal contributions for the EMF Research and Public Information Dissemination Program and continued more than 25 biomedical multi-year research projects managed by the National Institute of Environmental Health Sciences. Distributed over 150,000 copies of the first comprehensive Federal EMF publication (Q&A about EMF). 1997 - Perform experiments to determine dose effect characteristics of reported EMF hormonal effects and conduct research on cellular processes altered by EMF interactions. Continue intensive research to replicate key findings, using advanced EMF exposure systems at four Government laboratories. Initiate, through NIEHS, a number of small grants to fill research gaps. Continue intensive communication program: maintain EMF infoline; distribute Q&A booklet; and complete brochure about EMF in the workplace. 1998 - Complete experiments to identify the biophysical basis for replicable EMF biological effects and relevant EMF exposure parameters. Complete intensive research begun in FY 1996 to replicate key findings, using advanced EMF exposure systems at four Government laboratories. Complete a risk evaluation of potential human health effects from exposure to electric and magnetic fields (by NIEHS). Continue intensive communication program, including publication and distribution of booklets updated with most recent information.	$9,487	$8,000	$8,000
TOTAL Electric and Magnetic Fields R&D	**$9,487**	**$8,000**	**$8,000**

SOLAR AND RENEWABLE ENERGY

ELECTRIC ENERGY SYSTEMS AND STORAGE (Cont'd)

Climate Challenge	FY 1996	FY 1997	FY 1998
1996 - Number of signed agreements increased, major financial contributions achieved, and confirmed strong implementation of pledges by over 61% of the electric utility industry which contributed to a strong U. S. position during international climate change treaty negotiations. Fostered encouragement of new industry-wide initiative "Travel-Stop Electrification" to eliminate emissions by substituting electricity for idling truck engines. Climate Challenge received no appropriated funding in FY 1996. However, work was accomplished using prior year funds and DOE Staff personnel. 1997 - Using prior year funds and DOE Staff personnel, encourage participation to include a minimum of 650 electric utilities; report major utility accomplishments; summarize and publicize individual utility actions to stimulate replication; and contribute to a strong U. S. position during international Climate Change treaty negotiations. 1998 - Continue to increase participation to include a minimum of 750 electric utilities; continue to compile and report utility industry accomplishments; catalyze additional utility initiatives; and re-negotiate utility agreements stressing post-2000 commitments.	$0	$0	$1,000
TOTAL Climate Challenge	**$0**	**$0**	**$1,000**
TOTAL Electric Energy Systems and Storage	**$33,744**	**$31,750**	**$45,500**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

High Temperature Superconductivity R&D: The increase will maintain the technology edge that has secured a strong leadership position for U.S. manufacturers. The funds will be split as follows:

Superconductivity Partnership Initiative (SPI): The SPI co-funds industry-led projects for design of electrically powered equipment. Additional funds will be used to complete the present projects for power cables, and current limiters and to continue the motor project. Also, the funds will support 1-3 new project teams selected in a FY 1997 competition for new co-funded research projects on such equipment as transformers, generators, and alternatively designed power cables.

Second Generation Wire Initiative: Additional funds will be used to work with industry consortia to scale up national lab research discoveries.

FUNDING CHANGES FROM FY 1997 TO FY 1998 (Cont'd):

Strategic Research: Additional funds will be used for fundamental research by national lab, university and industry scientists needed for success of both the SPI and the second generation wire initiative.	
The additional funding will maintain the level of outstanding accomplishment shown so far in the program and support aggressive research that capitalizes on program research breakthroughs while expanding work on ground breaking system designs that will capture the energy and economic potential of the research investment	(+12,750,000)
Energy Storage R&D: There is no change in Energy Storage R&D proposed for FY 1998.	($0)
Electric and Magnetic Fields R&D: The net change of $0 has unknown effects at this time.	($0)
Climate Change: The increase of $1,000 provides funds to accelerate utility participation to approximately 100 utilities over the 1997 estimate of 650 electric utilities, and provide seed funds to catalyze additional utility initiatives.	($1,000)
	(+12,751,000)

SOLAR AND RENEWABLE ENERGY

PROGRAM DIRECTION - EE

I. Mission Supporting Goals/Ongoing Responsibilities:

A. Program Description

Program Direction provides the staffing resources and associated funding to support the management and oversight of the Solar and Renewable Energy Programs. This permits the continuation of a diverse array of Solar and Renewable projects to be integrated into a national portfolio of world renown research. Program Direction encompasses two principal activities: (1) Headquarters executive and program management; and (2) program operations at the Golden Field Office and the Idaho Operations Office.

Solar and Renewable Energy management is committed to reduce the costs for all administrative activities and achieve savings through a more streamlined and efficient management of federal staffing levels in this account. From the start of FY 1995 through the end of FY 1998, FTEs are projected to be reduced over 23% (38 FTEs), from an end-of-year (EOY) final, staffing "burn" rate of 164 FTEs in FY 1994 to an EOY of 126 FTEs in FY 1998. A major reorganization was implemented in FY 1996 which realigned employee staffing to accomplish DOE Strategic Alignment goals and to streamline administrative activities consistent with the Government Performance and Results Act. Specifically, downsizing management operations has provided for the elimination of management layers and for an increased supervisory span of control. Before the reorganization, the employee to supervisor ratio was 7 to 1; now it is 11 to 1.

B. The following major activities are included in Program Direction:

a. Salaries and benefits: Nearly 78% of the Program Direction funding is for salary and benefits for Federal employees at Headquarters and in the Field who manage and implement the Solar and Renewable Energy Programs.

b. Travel: Approximately 3% of the Program Direction funding supports the travel of Federal staff to perform on-site reviews and inspections of Solar and Renewable Programs which are implemented through out the United States and to attend scientific professional meetings.

c. Support services: None.

d. Other related expenses: A total of 6% of the Program Direction funding is requested for landlord functions (e.g., rent, utilities, telecommunications, supplies and materials) to permit the operation of the Golden Field Office.

e. Working capital fund: A total of 13% of the Program Direction funding is requested for the continuation of the Working Capital Fund.

II. Funding Schedule:

	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustments	FY 1997 Current Appropriation	FY 1998 Budget Request
GOLDEN FIELD OFFICE					
Salaries and Benefits	$1,883	$1,420	$0	$1,420	$1,465
Travel	300	150	0	150	150
Support Services	0	0	0	0	0
Other Related Expenses	681	0	0	0	882
Subtotal, Golden Field Office	**$2,864**	**$1,570**	**$0**	**$1,570**	**$2,497**
Full Time Equivalents	26	19	0	19	19
IDAHO OPERATIONS OFFICE					
Salaries and Benefits	$84	$175	$0	$175	$180
Travel	10	5	0	5	10
Support Services	0	0	0	0	0
Other Related Expenses	0	0	0	0	0
Subtotal, Idaho Operation office	**$94**	**$180**	**$0**	**$180**	**$190**
Full Time Equivalents	1	2	0	2	2
HEADQUARTERS					
Salaries and Benefits	$10,736	$10,380	$0	$10,380	$10,560
Travel	332	300	0	300	295
Support Services	0	0	0	0	0
Other Related Expenses	0	0	0	0	0
Working Capital Fund	0	2,052	0	2,052	2,100
Subtotal, Headquarters	**$11,068**	**$12,732**	**$0**	**$12,732**	**$12,955**
Full Time Equivalents	114	107	0	107	105
TOTAL PROGRAM DIRECTION					
Salaries and Benefits	$12,703	$11,975	$0	$11,975	$12,205
Travel	642	455	0	455	455
Support Services	0	0	0	0	0
Other Related Expenses	681	0	0	0	882
Working Capital Fund	0	2,052	0	2,052	2,100
Total, Program Direction	**$14,026**	**$14,482**	**$0**	**$14,482**	**$15,642**
Total Full Time Equivalents	141	128	0	128	126
Adjustments	(1,810) A	(1,380) A	0	(1,380) A	0
Total Budget Authority	**$12,216**	**$13,102**	**$0**	**$13,102**	**$15,642**

A. Use of prior-year balances.

III. Performance Summary:

Program Direction - EE	FY 1996	FY 1997	FY 1998
Salaries and Benefits: FY 1996 - A streamlined organization was implemented to manage the Solar and Renewable Energy Programs. All third-tier components were eliminated, the supervisory span of control was increased from 7 to 11 in 1996. Also, staffing was reduced from 141 FTEs in FY 1996 to 126 FTEs in FY 1998. FY 1997 - Staffing reductions will continue to be implemented in FY 1997 through the use of buyouts. To date, 6 federal employees took a buyout in FY 1997 costing an estimated $336,000. FY 1996, FY 1997, FY 1998 - Federal staff perform all program management activities, ranging from policy development and long-range planning to general administration including: (1) development of corporate goals, multi-year planning, corporate formulation and defense of budget requests; (2) preparation of technical research and development plans to achieve corporate goals; (3) assessment of scientific and technical needs and priorities, development; (4) review, evaluation, and funding of research proposals; (5) assessment of financial plans, monitoring of resource allocations for maximum technical performance, and aggressive monitoring of all uncosted balances; (6) integration into a coherent National research agenda of technical objectives from nearly 300 solar and renewable energy projects conducted at the DOE National Laboratories, other Federal agencies, colleges and universities, non-profit research and scientific organizations, technical entrepreneurs, small business and minority-owned research concerns, and commercial for-profit vendors; (7) monitoring, evaluation, and oversight of laboratory work and resource allocation; (8) oversight of university and industrial research programs; (9) oversight of interagency liaison, negotiations, and work activities; (10) management and execution of corporate-level communications, information transfer and outreach to Solar and Renewable Energy customers and stakeholders.	$12,703	$11,975	$12,205

SOLAR AND RENEWABLE ENERGY

PROGRAM DIRECTION - EE (Cont'd)

Program Direction - EE (Cont'd)	FY 1996	FY 1997	FY 1998
Travel: FY 1996 - Travel ceilings were reduced in accordance with a Secretarial initiative to reengineer travel by reducing the need for federal travel through the use of expanded and integrated telecommunications and videoconferencing networks. FY 1997 - Further reductions were implemented through additional increased use of teleconferencing facilities by management to conduct oversight of some field activities. FY 1998 - Travel reductions in FY 1997 have been offset by inflationary increases in travel and per diem costs leaving the FY 1998 Congressional request essentially unchanged from the FY 1997 estimate.	$642	$455	$455
Support Services: None.	$0	$0	$0
Other Related Expenses: FY 1996 - The costs for landlord functions at the Golden Field Office included: rental payments to others ($370); expendable office supplies and materials ($132); telecommunications and utilities costs ($95); training ($30); purchase of goods and services from Government accounts ($6); printing and graphics ($13); postage ($10); maintenance and service agreements ($5); publications ($2); and other operational costs ($18). The total costs for the operation of the Golden Field Office were split between the Energy Supply Research and Development Appropriation (ESR&D) and the Interior and Related Agencies (INT) Appropriation. FY 1997 - FY 1997 ESR&D appropriations are not sufficient to provide support for the landlord functions. Currently, all FY 1997 program direction appropriations are needed for Federal pay, benefits, and travel. This situation is being reassessed to determine if projected savings from buyouts and the Working Capital Fund will be achieved which can be used for landlord functions at the Golden Field Office.			

SOLAR AND RENEWABLE ENERGY

PROGRAM DIRECTION - EE (Cont'd)

Program Direction - EE (Cont'd)	FY 1996	FY 1997	FY 1998
Other Related Expenses (Cont'd): FY 1998 - Funding is requested to support the landlord functions associated with the operation of the Golden Field Office. This includes: rental payments to GSA and others ($390); expendable office supplies and materials ($160); telecommunications and utilities costs ($105); training ($30); purchase of goods and services from Government accounts ($17); printing and graphics ($15); postage ($10); maintenance and service agreements ($5); publications ($2); and other operational costs ($148). The total costs for the operation of the Golden Field Office are split between the Energy Supply Research and Development Appropriation (ESR&D) and the Interior and Related Agencies (INT) Appropriation.	$681	$0*	$882
Working Capital Fund: FY 1996, FY 1997, FY 1998 - The Working Capital Fund will permit the costs of administrative services, which are common to all recipient organizations, to be charged directly to those organizations. The Fund offers a variety of benefits. For example, it will enhance the potential for reducing administrative costs by permitting managers to reduce the consumption and costs for goods and services previously perceived as "free", it will promote more efficient allocation of goods and services, and it will permit the Solar and Renewable Energy Programs to move toward implementing the "fully loaded cost" estimation sought by the Conference Managers in the FY 1996 Energy and Water Appropriations Report. Funding for FY 1996 reflects zero because FY 1996 activities were funded out of the Departmental Administration account.	$0	$2,052	$2,100
Subtotal Program Direction	***$14,026***	***$14,482***	***$15,642***
Adjustment	**$-1,810**	**$-1,380**	**$0**
Total Budget Authority, Program Direction	**$12,216**	**$13,102**	**$15,642**

* If projected savings are realized in FY 1997, an estimated $800 will be used for landlord functions at the Golden Field Office as follows: rental payments to GSA and others ($378); expendable office supplies and materials ($160); telecommunications and utilities costs ($100); training ($35); purchase of goods and services from Government accounts ($17); printing and graphics ($15); postage ($10); maintenance and service agreements ($5); publications ($2); and other operational costs ($78). The total costs for the operation of the Golden Field Office have been split between the

Energy Supply Research and Development Appropriation (ESR&D) and the Interior and Related Agencies (INT) Appropriation.

IV. ***EXPLANATION OF FUNDING CHANGES FY 1997 TO FY 1998*****:**

The FY 1998 increase of $1,160,000 is based on FY 1997 total obligational authority of $14,482,000 ($13,102,000 in new FY 1997 budget authority and $1,380,000 in FY 1997 unobligated carryover) as shown in the following table:

(dollars in thousands)

Funding Source	FY 1996	FY 1997	FY 1998	$ Change	% Change
New Budget Authority	$ 12,216	$ 13,102	$ 15,642	+$2,540	
Unobligated Carryover	1,810	1,380	0	-1,380	
Total, Obligational Authority	**$ 14,026**	**$ 14,482**	**$ 15,642**	**+$1,160**	**+8%**

Salaries and benefits: An increase of $230,000 (1.9%) reflects a portion of the inflationary cost-of-living increases projects in FY 1998.	(+$230,000)
Travel: The FY 1998 request is the same as the FY 1997 appropriation.	($0)
Support services: None.	($0)
Other related expenses: An increase of $882,000 will support landlord functions for the Golden Field Office and the balance of $48,000 (a 2% increase) is for the Working Capital Fund and reflects inflationary costs for the business lines associated with communication services and expendable supplies**.**	(+$930,000)
Total	**(+$1,160,000)**

SOLAR AND RENEWABLE ENERGY

PROGRAM DIRECTION - EE (Cont'd)

Support Services	FY 1996 ($000)	FY 1997 ($000)	FY 1998 ($000)	FY 1998/FY 1997 Change ($000)
Technical Support Service				
Feasibility of Design Considerations	$0	$0	$0	$0
Economic and Environmental Analysis	0	0	0	0
Test and Evaluation Studies	0	0	0	0
Subtotal	**$0**	**$0**	**$0**	**$0**
Management Support Services				
Management Studies	0	0	0	0
Training and Education	0	0	0	0
ADP Support	0	0	0	0
Subtotal	**$0**	**$0**	**$0**	**$0**
Total Support Services	**$0**	**$0**	**$0**	**$0**

SOLAR AND RENEWABLE ENERGY

PROGRAM DIRECTION - EE (Cont'd)

PROGRAM DIRECTION - OTHER RELATED EXPENSES

Other Related Expenses	FY 1996 ($000)	FY 1997 ($000)	FY 1998 ($000)	FY 1998/FY 1997 Change ($000)
Training	$0	$0	$0	$0
Working Capital Fund	0	2,052	2,100	+48
Printing and reproduction	20	0	15	+15
Rental Space	300	0	390	+390
Software Procurement/Maintenance Activities/Capital	0	0	5	+5
Other	361	0	472	+472
Total Obligational Authority	**0**	**0**	**0**	**0**
Use of Prior Year Balances	0	0	0	0
Total Budget Authority	**$681**	**$2,052**	**$2,982**	**+$930**

Other Related Expenses: (dollars in thousands) The increase of $930 in FY 1998 is the result of a $48 increase (2% increase) in the Working Capital Fund which covers the projected inflationary costs for the business lines associated with communication services and expendable supplies. The balance of the increase, a total of $882, is for other related expenses and is the result of $0 funding in FY 1997. Currently, all FY 1997 program direction appropriations are needed for Federal pay, benefits, and travel. This situation will be reassessed to determine if projected savings from buyouts and the Working Capital Fund will be achieved which can be used for landlord functions at the Golden Field Office. In FY 1998 $882 is requested to support landlord functions associated with the operation of the Golden Field Office including: rental payments to GSA and others ($390); expendable office supplies and materials ($160); telecommunications and utilities costs ($105); training ($30); purchase of goods and services from Government accounts ($17); printing and graphics ($15); postage ($10); postage ($10); maintenance and service agreements ($5); publications ($2); and other operational costs ($138).

SOLAR AND RENEWABLE RESOURCE TECHNOLOGIES

RESOURCE ASSESSMENT

I. Mission Supporting Goals and Objectives: Reliable information on renewable energy resources is essential for the successful design, planning, and deployment of renewable technologies. This information is being developed in ways such that it can be displayed geographically and also temporarily to determine how the various technologies will perform at different locations, and how renewable technologies might be integrated into electric utility systems or be deployed as stand-alone systems. U.S. and international data bases for various renewable technologies are being incorporated into a multi-resource data base at the National Renewable Energy Laboratory (NREL). Products from these data bases are being made available through NREL's Renewable Energy Data Center. Geographic Information Systems are being used as a tool to display resource information, with a particular focus currently on solar and wind resources. Planning for incorporating other renewable resource information into the data base and making it available through the Renewable Energy Data Center has also begun. Due to budget constraints, no program funds are being requested in FY 1998.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	%
Resource Assessment	$ 1,869	$ 0	$ 0	$ 0	0%
Total, Resource Assessment	**$ 1,869**	**$ 0**	**$ 0**	**$ 0**	**0%**

III. Performance Summary - Accomplishments:

Resource Assessment	FY 1996	FY 1997	FY 1998
1996 - Continue activities related to data collection, analysis and dissemination.			
1997 - No funding appropriated. Program closeout with prior year funds.			
1998 - No funding requested.	1,869	0	0
TOTAL Resource Assessment	**$1,869**	**$0**	**$0**

FUNDING CHANGES FROM FY 1997 TO FY 1998:

Resource Assessment: No funding requested.	($0)

DEPARTMENT OF ENERGY
FY 1998 CONGRESSIONAL BUDGET REQUEST
Energy Efficiency and Renewable Energy
(Dollars in Thousands)

FY 1998 COMPARABILITY MATRIX

Solar and Renewable Energy/Energy Supply Research and Development

FY 1996 STRUCTURE	FY 1998 Cong. Request structure / FY 1996 Enacted Structure	Solar Bldg	Photo-voltaic	Solar Thermal	Biofuels	Wind	REPI	Resource Assessmnt	In't Solar	Solar Tech Tran	Geo-thermal	Hydro-power	Hydrogen R&D	Electric Energy & Storage	NREL	Program Dirn	Fixed Assets Acct	Total
	Solar Bldgs	1,925																1,925
	Photovoltaic		61,268															61,268
	Solar Thermal			24,011														24,011
	Biopower/ Biofuels				53,198													53,198
	Wind					31,420												31,420
	Solar Program Support						658											658
	Resource Assessment							1,869										1,869
	International Solar								3,881									3,881
	Solar Tech Trans									10,779								10,779
	Geothermal										29,399							29,399
	Hydropower											3,483						3,483
	Hydrogen R&D												14,331					14,331
	Electric Energy & Storage													33,744				33,744
	NREL														500		1,500	2,000
	Program Direction															12,216		12,216
	TOTAL	1,925	61,268	24,011	53,198	31,420	658	1,869	3,881	10,779	29,399	3,483	14,331	33,744	500	12,216	1,500	284,182